REPORT

Stormwater Management System Design Report

Capital Region Resource Recovery Centre

Submitted to:

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1.0 INTRODUCTION

A new integrated waste management facility, the Capital Region Resource Recovery Centre (CRRRC), is proposed for the Capital Region of eastern Ontario. The CRRRC will provide facilities and capacity for the recovery of resources and diversion of materials from wastes that are generated by Industrial, Commercial and Institutional (IC&I) and Construction and Demolition (C&D) sectors in Ottawa and eastern Ontario. It will also provide landfill disposal capacity on the same Site for post-diversion residuals and materials that are not diverted.

This report has been prepared to describe the proposed drainage and stormwater management for the development of the CRRRC in support of the Site Plan Application to the City of Ottawa. This report should be read in conjunction with the engineering drawings enclosed.

1.1 Background

The proposed CRRRC Site (the Site) is located in the east part of the City of Ottawa just southeast of the Highway 417/ Boundary Road interchange. The property is located on the east side of Boundary Road, north of Devine Road and west of Frontier Road, and east of an existing industrial park, on Lots 22 to 25, Concession XI, the former Township of Cumberland.

The Site, totalling approximately 192 hectares (ha), is located in the Bear Brook Subwatershed in the Lower Ottawa – South Nation Watershed. The area surrounding the Site primarily consists of rural and agricultural land, an industrial park, residential properties and open spaces. Figure 1 shows the Site and surrounding area. The Site is generally flat, and slopes from local high point elevations at the western side of the Site at Boundary Road, towards the lowest portion of the Site found along the eastern edge at Frontier Road. The Mer Bleue bog is about 3.7 km to the north/northwest of the Site.

The property is adjacent to an existing Industrial Park with few existing immediate neighbours. It is underlain by a surficial silty sand layer followed by a thick deposit of silty clay soil.

2.0 ASSESSMENT OF EXISTING SURFACE WATER CONDITIONS

Hydrologic Model

A hydrological model was used to calculate surface water runoff and peak flows in the area of the proposed CRRRC under existing conditions, using design storms with return periods from 2 through 100 year as set out in *Ontario Regulation* (O.Reg.) 232/98 (MOE, 1998). To assist with the assessment and designs, Golder prepared a SWM model for the Site using the U.S. Environmental Protection Agency Stormwater Management Model Version 5.0.02 ('SWMM5') software program (US-EPA, 2008). The SWMM5 software was used to estimate the hydrologic pre-development conditions for the Site's sub catchment areas.

SWMM5 is widely used for single event and long-term (continuous) simulation of runoff quantity from urban and non-urban areas. In the runoff component, sub-catchment areas receive precipitation and generate runoff. The routing portion then transports this runoff through a system of pipes, channels and storage reservoirs that are user defined. SWMM5 tracks the quantity of runoff generated within each sub-catchment, and the flow rate and flow depth of water in each pipe and channel during a simulation period comprised of multiple time steps.

Drainage

A small portion of the northern section of the Site is currently used for agricultural purposes, but the majority of the Site is heavily vegetated and treed. The Site is known to have generally high groundwater levels, minimal relief and gradual slope of typically less than 1% draining west to east, with elevations ranging from approximately 78 metres to 76 metres above sea level (masl). Soils encountered in the Site area during the subsurface investigation program consisted of topsoil over a layer of silty sand with a thickness of up to approximately 1.5 metres, underlain by an extensive and thick silty clay deposit. Based on these investigations, Site visits performed by the Golder team, aerial photography and available topography, the model hydrologic parameters, including Soil Conservation Service (SCS) Curve Number, depression storage, Manning's coefficient and land use were defined for the pre-development drainage areas. Other user-defined hydrologic parameters applied in the SWMM5 hydrologic model are area, width, slope, and percentage impervious surfaces. All of the hydrologic input parameters for the modeling are summarized in Attachment A.1.

Drainage in the vicinity of the Site is mainly by means of a network of agricultural ditches and three municipal drains. Ditches that cross the Site, some of which are old farm field drainage, have not been maintained. There are roadside ditches along Boundary, Devine and Frontier Roads that eventually all drain eastward. At present, drainage on the Site is not well established and the land is poorly drained. Sub-catchment delineation is challenging due to the poorly drained land and many references, including municipal drainage plans, were used. Ultimately, delineations were based on those previously concluded by Stantec (Stantec, 2000). Delineated pre-development drainage catchments are presented in Figure 1.

The Site is in the headwaters of the Shaw's Creek sub-watershed of approximately 35 km^2, and the Bear Brook watershed of approximately 484 km^2. Bear Brook is a tributary to the South Nation River and the Site is therefore within the South Nation Conservation area. The Site contributes roughly 5% of the land area draining to the Shaw's Creek drainage area.

The Site is divided into three sub-catchment areas with discharge to the eastern boundaries of the Site. The discharge ditches of the three sub-catchments all eventually tie into municipal drains. Summaries for each of these Site drainage areas, including additional descriptions of off-Site downstream routing to Highway 417, are provided below. The SWMM5 schematic illustrating the existing drainage is provided in Attachment A.2.

Regimbald Municipal Drain

The northern Site sub-catchment area primarily drains to two on-Site agricultural ditches. One ditch segment drains northerly from the Site while another drains easterly towards Frontier Road. Both ditch segments eventually become part of the Regimbald Drain, the first about 200 metres north of the northern property limit, while the second at the east side of Frontier Road.

Drainage to the east is conveyed via a 600 millimetre diameter culvert under Frontier Road. Off-Site drainage from this sub-catchment area is then conveyed northeast via a ditch to a 1,000 millimetre diameter culvert under Highway 417, meeting up with the other branch of the Regimbald Drain approximately 800 metres northeast of Highway 417.

The Site drainage to the northern ditch segment appears to be relatively insignificant based on Site observations. For the purposes of the assessment it has been considered that the east discharge location is the outlet for the northern portion of the Site. The portion of the Site draining to the Regimbald Drain is about 21 ha, or about 11% of the Site.

Simpson Municipal Drain

The Simpson Municipal Drain bisects the Site and drains from west to east. An upstream drainage area drains to the Simpson Drain segment through the Site, extending to the west of Boundary Road, along Mitch Owens Road to Black Creek Road.

The runoff from the central portions of the Site is directed to the Simpson Municipal Drain and is conveyed off-Site and then discharges through a 1,200 mm diameter culvert under Frontier Road. Downstream, the Simpson Drain continues to a culvert under Highway 417 approximately 1 km further east of the Site. Downstream of Highway 417, the Simpson Drain continues as Shaw's Creek, which eventually feeds Bear Brook Creek. The stream flow distance of the Simpson Municipal Drain from the east perimeter Site boundary to Bear Brook Creek is approximately 11 km.

The portion of the Site draining to the Simpson Drain is about 75.6 ha, or about 39% of the Site.

Wilson - Johnston Municipal Drain

The southern portion of the Site is primarily drained by a ditch flowing west to east across the entire width of the Site. This ditch extends west to Boundary Road but only receives runoff from the eastern half of the road allowance as the western portion connects to the Simpson Drain at Mitch Owens Road. This ditch continues to flow east and eventually becomes part of the Wilson-Johnston Municipal Drain downstream of the Site.

Off-Site flows from the Site are routed under Frontier Road, via a 1,000 mm diameter culvert. The ditch then turns south and parallels Frontier Road for about 150 metres before turning back to the east. The Wilson-Johnston Drain crosses under Highway 417 via a culvert about 2.4 km east of the Site.

A second small ditch in the southeast corner of the Site drains east to Frontier Road and crosses under the road via a 600 mm culvert and ties into the main ditch at the location where it turns east.

Some drainage along the southern limits of the Site may drain to the roadside ditch along Devine Road. It doesn't appear that very much runoff follows this route and it is difficult to estimate how much, due to the very flat topography. Since the Devine Road drainage also eventually connects into the Wilson-Johnston Drain, it has been assumed that no runoff from the Site discharges to Devine Road.

The portion of the Site draining to the Wilson-Johnston Drain is about 95.1 ha, or about 50% of the Site.

2.1 Water Quantity

Flow measurements were conducted at the Site during the Environmental Assessment (EA) approval process. The conditions at the time of sampling resulted in very low or no flow conditions in many cases or unreliable information in others. This prevented successful determination of consistent flow quantities. As a result, this data was not used in preparation of the SWM model nor for calibration.

A hydrological model using SWMM5 was used to calculate surface water runoff and peak flows in the area of the proposed CRRRC under existing conditions, using design storms with return periods of 2 through 100 year as set out in O.Reg. 232/98 (MOE, 1998).

Precipitation conditions on-Site are represented by the record from Environment Canada's Ottawa CDA RCS meteorological station. The station is located approximately 20 km northwest of the Site at 45°23'N 75°43'W and an elevation of 79 masl. Rainfall depths for 24-hour storms were extracted from the Ottawa short duration rainfall Intensity-Duration-Frequency (IDF) data. Rainfall depths for 6-hour Historical rainfall storms (August 8, 1996 and August 4, 1988) were also extracted from Environment Canada's Ottawa CDA RCS meteorological station and used as a comparison measure.

The collection, conveyance and detention of runoff through the Site were modelled. The modelling data denotes the extent of knowledge on the quantity of surface runoff water from the Site. The values from the hydrological modelling are presented in Table 1.

Table 1: Estimated Pre-Development Peak Flow Rates

	Peak Flow (L/s)					
	24 Hour Design Storm					
Sub-Catchment Area	1:2 Year	1:5 Year	1:10 Year	1:25 Year	1:50 Year	1:100 Year
Regimbald (Northern)	86	298	375	471	535	556
Simpson (Central)	35	284	406	585	732	899
Wilson-Johnston (Southern)	40	345	495	715	898	1106

The Regimbald sub-catchment experiences the highest peak flows for the 1:2 year event, while the Wilson-Johnston Drain experiences the highest peak flows in all the other design storm events.

3.0 STORMWATER MANAGEMENT DESIGN CRITERIA AND OBJECTIVES

The objectives of the SWM design are to:

1) Control post-development stormwater discharges from the Site to the three Municipal Drain watersheds at or below pre-development rates, for the 1 in 2 year to 1 in 100 year design storm events; and,

2) Minimize sediment loading in runoff leaving the Site during and post-construction, to adhere to the MOECC Guidelines for Enhanced Level of treatment (80% Total Suspended Solids (TSS) removal) or greater (MOE, 2003).

The SWM design criteria for the Site to meet the above objectives are set out in following:

- The City of Ottawa, Stormwater Control Quantity and Surface Water Quality Policies (City of Ottawa, 2009).
- O.Reg. 232/98 for Landfilling Sites (MOE, 1998).
- The Ontario MOECC SWM Pond sizing guidelines for impervious area percentages to achieve TSS removal objectives (MOE, 2003).

Table 2 below summarizes the SWM criteria presented in this design report.

Table 2: Site SWM Design Criteria

Criterion	Description	Target
Peak Runoff Control	1 in 2 year to 1 in 100 year runoff events	Post-development peak flows at/below pre-development
Conveyance Capacity	Internal drainage ditches and culverts	Design Capacity to accommodate 1 in 25 year design storm
	Storm Sewers	Design Capacity to accommodate 1 in 2 year design storm
	Continuous overland flow route	Convey the peak flow from the 1 in 100 year design storm
Stormwater Water Quality	Total Suspended Solids (TSS)	Enhanced level of treatment (80% TSS removal) (MOE, 2003)

4.1 Surface Water Quantity

Since the proposed project has the potential for effects on surface water management, predicted impacts were assessed with consideration of mitigation measures. Several mitigation measures are incorporated into the Site design to manage surface water quantity and minimize potential off-Site impacts. Mitigation options were explored by routing runoff to different outlets in the SWMM5 model and used to predict changes in water quantity.

As previously discussed, there are three main drainage areas on-Site that convey drainage off-Site.

3.1.1 Predicted Changes in Drainage Areas

The post-development conditions scenario considers the Site layout for the ultimate build-out of the CRRRC facilities, the landfill final cover, and the SWM controls shown on Figure 3.

The three Site sub-catchment drainage areas and corresponding land uses for the proposed ultimate build-out state of the Site, and the technical details of the proposed SWM controls for each sub-catchment are described below in more detail. Figure 4 shows individual sub-catchments for each SWM Pond.

The SWMM5 schematic illustrating the proposed routing of post-development Site drainage is provided in Attachment A.2, Figure A-2. The sub-catchment areas on Figure A-2 are shown on Figure 4.

Regimbald Municipal Drain

The proposed northern Regimbald Municipal Drain sub-catchment area will increase by 3.3 ha, to a total sub-catchment area of 24.3 ha. The proposed grading and servicing plans route the drainage from this part of the CRRRC facility area to the two cell SWM Pond. This post-development Site sub-catchment area includes buildings, parking areas, roadways, stockpile areas, preserved existing and/or landscaped green space, and the two SWM cells (Ponds 5a and 5b) located in the central area of this sub-catchment.

Simpson Municipal Drain

The proposed Simpson Municipal Drain post-development total sub-catchment area of approximately 83.8 ha increases from existing conditions by approximately 8.2 ha.

This post-development drainage area is proposed to control runoff via a pond northwest and northeast of the Simpson Drain (Ponds 3, 4a and 4b), and one pond southwest of the drain (Pond 1). The area north of the Drain will include pads for the composting operations and soil treatment facilities, buildings, roadways and leachate storage ponds. The area south of the Simpson Drain will include the northwest segment of the landfill.

Wilson - Johnston Municipal Drain

The post-development final build-out sub-catchment area to the Wilson-Johnston Drain will decrease by approximately 11.5 ha, from 95.1 ha to 83.6 ha. This area will include approximately two-thirds of the landfill area and will include one long pond located along the southern and eastern sides of the Site.

A summary of existing and proposed drainage areas is presented in Table 3.

Table 3: Existing and Proposed Drainage Areas

Site Municipal Drain Sub-catchment	Area (ha)	
	Existing	Proposed
Regimbald	21.0	24.3
Simpson	75.6	83.8
Wilson-Johnston	95.1	83.6
Total Site	***191.7***	***191.7***

The total drainage area is not expected to change. The Regimbald Municipal Drain still has the smallest drainage area, and the Simpson and Wilson-Johnston Municipal Drains will have identically sized drainage areas.

4.0 STORMWATER MANAGEMENT DESIGN

Design drawings for the Site grading and proposed stormwater control works are required for the various approvals. The stormwater infrastructure consists of:

- SWM Ponds
- Conveyance Channels (Ditches, Spillways, Outfall Channels)
- Culverts
- Storm Sewers

A set of Design Drawings is provided and includes drawings of the SWM Ponds, typical sections of the conveyance features, and typical details of berms, along with a grading information, and erosion and sediment control information. The following sections summarize the detailed design of the SWM and conveyance features for the Site.

Throughout the course of the Site development, the phased construction of the landfill area will be conducted such that any contact-runoff is contained within the limit of the proposed waste footprint, through a series of berms. Buffer zones of existing and constructed vegetation screening will be maintained. Erosion and Sediment Control (E&SC) measures, including perimeter silt fencing, will also be installed and maintained between the vegetation screening area and the perimeter road during the phased construction of the landfill.

4.1 SWM Pond Design

The SWM Pond design plans, sections and details are included in the Design Drawings. A summary of the SWM Pond dimensions and capacities for each feature are outlined in the sections below.

To improve the settling of TSS within the permanent pool, SWM Ponds 1, 2, 3, and 4b will be constructed with a forebay equal to approximately 1/5 of the width and length of the pond bottom. Due to the long, linear nature of most of the SWM Ponds, some of the runoff entering the ponds will bypass the forebays. To assist with removal of TSS, it is proposed that much of the runoff for these areas be promoted to enter the ponds as sheet flow across vegetated buffer areas adjacent to the ponds. To avoid re-suspension of accumulated sediments and flushing of the ponds during major storm events exceeding the 1 in 100 year event, a pond bypass/overflow would convey excess flow to the outlet.

4.1.1 Pond 1

4.1.1.1 Quality Control

SWM Pond 1 collects surface water runoff from the northwest portion of the landfill. There is a perimeter ditch around the base of the landfill which will collect and convey surface water to the Pond. The outlet structure is a 1200 mm diameter HDPE pipe with a 75 mm control orifice at elevation 76.0 m and a 400 mm control orifice at elevation 76.80which provides a 40-hour retention time for runoff produced by a 25 mm design storm. An overflow weir is also included at elevation 77.60 m. The 25 mm design storm hydrograph for Pond 1 is provided in Attachment A.3 The total drainage area is approximately 48.2 ha (Drainage Area 204 on Figure 4). SWM Pond 1 discharges to the Simpson Municipal Drain.

Table 3.2 of the MOE SWM Planning and Design Manual (2003) provides storage volume design requirements based on specific site imperviousness levels to achieve required TSS removal objectives. Table 3.2 indicates that the minimum storage volume should be based on 140 m^3/ha for Enhanced 80% long-term TSS removal and an impervious level of 35%. For an area of 48.2 ha, this results in a required storage volume of approximately 6,748 m^3, of which 40 m^3/ha is required for extended detention and the remainder representing the permanent pool. The proposed pond provides a permanent pool storage volume of approximately 4,867 m^3 and an extended detention storage volume of 8,261m^3 exceeding the requirements of 4,820 m^3 and 1,928 m^3 for permanent pool and extended detention respectively.

The following table provides the design values for the wet pond and compares these values to the minimum or preferred criteria as per Table 4.6 of the MOECC Manual:

Table 4: Pond 1 - MOECC Design Criteria

Design Element	Design Value	Comparison to MOECC Criteria
Drainage Area	48.2 ha	Meets Preferred Criteria
Treatment Volume	Permanent Pool – 4,867 m^3 Active Storage – 8,261m^3	Exceeds Preferred Criteria
Forebay	Depth – 1.85 m Maximum Area – 21.4% of total area	Exceeds Minimum Criteria
Length-to-Width Ratio	Overall – 27.9:1 Forebay – 6.0:1	Exceeds Preferred Criteria
Permanent Pool Depth	Maximum Depth – 1.85 m Mean Depth – 1.68 m	Meets Preferred Criteria
Active Storage Depth	Water Quality and Erosion Control – 0.68 m Total Depth – 1.52 m	Exceeds Preferred Criteria
Side Slopes	3:1, 4:1, 7:1	Minimum 5:1 Safety Criteria Not Met (landfill site with restricted access)
Inlet	Ditch at 0.35% from west and 1.5% from east	Meets Minimum Criteria
Outlet	1200 mm dia. outlet pipe with a 75 mm control orifice at elevation 76.0 m and a 400 mm control orifice at elevation 76.80, 1.0% slope 6 m wide overflow weir at 77.60	Exceeds Preferred Criteria

The following calculations summarize the design requirements of the forebay as per Section 4.6.2 of the MOECC Manual:

Forebay Settling Length

$$Dist = \sqrt{\frac{rQ_p}{V_s}}$$

Where:	Dist	=	forebay length (m)
	r	=	length-to-width ratio
	Q_p	=	peak flow rate from the pond during design quality event (25 mm storm event) (m^3/s)
	V_s	=	settling velocity (m/s)

$$Dist = \sqrt{\frac{6.0(0.003)}{0.0003}}$$

Dist = 7.7 m

Dispersion Length

$$Dist = \frac{8Q}{dV_f}$$

Where:	Dist	=	length of dispersion (m)
	Q	=	inlet pipe capacity (10 year storm event) (m^3/s)
	d	=	depth of permanent pool in the forebay (m)
	V_f	=	desired velocity in the forebay (m/s)

$$Dist = \frac{8(2.765)}{1.85(0.5)}$$

Dist = 23.9 m

The proposed forebay length is 59.6 metres and is therefore greater than the required lengths for settling and dispersion.

Minimum Forebay Bottom Width

$$Width = \frac{Dist}{8}$$

$$Width = \frac{23.9}{8}$$

Width = 3.0 m

The proposed bottom width is 3.4 metres and is therefore greater than the required width.

4.1.1.2 Quantity Control

SWM Pond 1 discharges to the Simpson Municipal Drain. The peak flows comparing the post-development flows to the pre-development flows for each drain can be found in Section 4.1.8. The post-development controlled peak flow, storage volume, and depth above permanent pool for Pond 1 can be found in Table 5 below.

Table 5: Pond 1 Quantity Control Results

Return Period	Post-Development Controlled Peak Flow (L/s)	Storage Volume (m^3)	Depth above Perm. Pool (m)
25 mm 4-hr	0.0	92	0.02
1:2 year	10	8,261	0.68
1:5 year	54	13,181	0.97
1:10 year	132	16,269	1.18
1:25 year	202	19,346	1.31
1:50 year	242	22,070	1.45
1:100 year	443	23,496	1.52

4.1.2 Pond 2

4.1.2.1 Quality Control

SWM Pond 2 collects surface water runoff from the southern and northeastern portion of the landfill. There is a perimeter ditch around the base of the landfill which will collect and convey surface water to the Pond. The outlet structure is a 450 mm diameter HDPE pipe with a 160 mm diameter orifice at elevation 75.35 and a 750 mm diameter HDPE pipe at elevation 76.05 which provides an 80-hour retention time for runoff produced by a 25 mm design storm. An overflow weir at elevation 76.60 m is also included. The 25 mm design storm hydrograph for Pond 2 is provided in Attachment A.3. The total drainage area is approximately 83.62 ha (Drainage Area 301, 302 and 303 on Figure 4). SWM Pond 2 discharges to the Wilson-Johnston Municipal Drain watershed.

Table 3.2 of the MOE SWM Planning and Design Manual (2003) provides storage volume design requirements based on specific site imperviousness levels to achieve required TSS removal objectives. Table 3.2 indicates that the minimum storage volume should be based on 140 m^3/ha for Enhanced 80% long-term TSS removal and an impervious level of 35%. For an area of 88.62 ha, this results in a required storage volume of approximately 11,707 m^3, of which 40 m^3/ha is required for extended detention and the remainder representing the permanent pool. The proposed pond provides a permanent pool storage volume of approximately 10,650 m^3 and an extended detention storage volume of 15,829m^3 exceeding the requirements of 8,362 m^3 and 3,345 m^3 for permanent pool and extended detention respectively.

The following table provides the design values for the wet pond and compares these values to the minimum or preferred criteria as per Table 4.6 of the MOECC Manual:

Table 6: Pond 2 - MOECC Design Criteria

Design Element	Design Value	Comparison to MOECC Criteria
Drainage Area	83.62 ha	Meets Preferred Criteria
Treatment Volume	Permanent Pool – 10,650 m^3 Active Storage – 15,829m^3	Exceeds Preferred Criteria
Forebay	Depth – 1.3 m Maximum Area – 20.0% of total area	Exceeds Minimum Criteria
Length-to-Width Ratio	Overall – 91.3:1 Forebay (north) – 3.1:1 Forebay (south) – 15.4:1	Exceeds Preferred Criteria
Permanent Pool Depth	Maximum Depth – 1.5 m Mean Depth – 1.4 m	Meets Preferred Criteria
Active Storage Depth	Water Quality and Erosion Control – 0.81m Total Depth – 1.36 m	Exceeds Preferred Criteria
Side Slopes	3:1, 4:1, 7:1	Minimum 5:1 Safety Criteria Not Met (landfill site with restricted access)
Inlet	Ditch at 0.35% from north and 0.3% from west	Meets Minimum Criteria
Outlet	450 mm dia. pipe with a 160 mm diameter orifice at elevation 75.35 and a 750 mm diameter HDPE pipe at elevation 76.05, 1.0% slope 10 m wide overflow weir at elevation 76.60	Exceeds Preferred Criteria

The following calculations summarize the design requirements of the forebay as per Section 4.6.2 of the MOECC Manual:

Forebay Settling Length

$$Dist = \sqrt{\frac{rQ_p}{V_s}}$$

Where: Dist = forebay length (m)

r = length-to-width ratio

Q_p = peak flow rate from the pond during design quality event (25 mm storm event) (m^3/s)

V_s = settling velocity (m/s)

$$Dist = \sqrt{\frac{3.1(0.001)}{0.0003}}$$

Dist = 3.2 m

Dispersion Length

$$Dist = \frac{8Q}{dV_f}$$

Where: Dist = length of dispersion (m)

Q = inlet pipe capacity (10 year storm event) (m^3/s)

d = depth of permanent pool in the forebay (m)

V_f = desired velocity in the forebay (m/s)

$$Dist = \frac{8(2.491)}{1.3(0.5)}$$

Dist = 30.7 m

The proposed forebay length is 42 metres and is therefore greater than the required lengths for settling and dispersion.

Minimum Forebay Bottom Width

$$Width = \frac{Dist}{8}$$

$$Width = \frac{30.7}{8}$$

Width = 3.8 m

The proposed bottom width is 4.32 metres and is therefore greater than the required width.

4.1.2.2 Quantity Control

SWM Pond 2 discharges to the Wilson-Johnston Municipal Drain. The peak flows comparing the post-development flows to the pre-development flows for each drain can be found in Section 4.1.8. The post-development controlled peak flow, storage volume, and depth above permanent pool for Pond 2 can be found in Table 7 below.

Table 7: Pond 2 - Quantity Control Results

Return Period	Post-Development Controlled Peak Flow (L/s)	Storage Volume (m^3)	Depth above Perm. Pool (m)
25 mm 4-hr	1.0	257	0.02
1:2 year	47	15,829	0.81
1:5 year	134	17,854	0.87
1:10 year	259	23,359	1.01
1:25 year	587	36,592	1.26
1:50 year	870	39,708	1.31
1:100 year	1218	42,600	1.36

4.1.3 Pond 3

4.1.3.1 Quality Control

SWM Pond 3 collects surface water runoff from the west portion of the industrial portion of the Site. There are a series of ditches and culverts which collect surface water runoff from the Site entrance, drop-off area, administration building and parking, and petroleum hydrocarbon soil treatment area. The outlet structure is a 450 mm diameter HDPE pipe with a 75 mm orifice at elevation 75.25 and a 600 mm diameter HDPE pipe with a 400 mm orifice at elevation 76.20 which provides a 40-hour retention time for runoff produced by a 25 mm design storm. An overflow weir at elevation 76.60 m is also included. The 25 mm design storm hydrograph for Pond 3 is provided in Attachment A.3. The total drainage area is approximately 11.30 ha (Drainage Area 201 on Figure 4). SWM Pond 3 discharges to the Simpson Municipal Drain.

Table 3.2 of the MOE SWM Planning and Design Manual (2003) provides storage volume design requirements based on specific site imperviousness levels to achieve required TSS removal objectives. Table 3.2 indicates that the minimum storage volume should be based on 190 m^3/ha for Enhanced 80% long-term TSS removal and an impervious level of 55%. For an area of 11.30 ha, this results in a required storage volume of approximately 2,147 m^3, of which 40 m^3/ha is required for extended detention and the remainder representing the permanent pool. The proposed pond provides a permanent pool storage volume of approximately 1,730 m^3 and an extended detention storage volume of 1,717m^3 exceeding the requirements of 1,695 m^3 and 452 m^3 for permanent pool and extended detention respectively.

The following table provides the design values for the wet pond and compares these values to the minimum or preferred criteria as per Table 4.6 of the MOECC Manual:

Table 8: Pond 3 - MOECC Design Criteria

Design Element	Design Value	Comparison to MOECC Criteria
Drainage Area	11.30 ha	Meets Preferred Criteria
Treatment Volume	Permanent Pool – 1,730 m^3 Active Storage – 1,717m^3	Exceeds Preferred Criteria
Forebay	Depth – 1.5 m Maximum Area – 24.7% of total area	Exceeds Minimum Criteria
Length-to-Width Ratio	Overall – 11.5:1 Forebay – 3.0:1	Exceeds Preferred Criteria
Permanent Pool Depth	Maximum Depth – 1.5 m Mean Depth – 1.5 m	Meets Preferred Criteria
Active Storage Depth	Water Quality and Erosion Control – 0.50 m Total Depth – 1.42 m	Exceeds Preferred Criteria
Side Slopes	4:1	Minimum 5:1 Safety Criteria Not Met (landfill site with restricted access)
Inlet	Ditch at 0.15%	Meets Minimum Criteria
Outlet	450 mm dia. pipe with a 75 mm orifice at elevation 75.25 and a 600 mm dia. pipe with a 400 mm orifice at elevation 76.20, 1.0% slope 10 m wide overflow weir at elevation 76.60	Meets Minimum Criteria

The following calculations summarize the design requirements of the forebay as per Section 4.6.2 of the MOECC Manual:

Forebay Settling Length

$$Dist = \sqrt{\frac{rQ_p}{V_s}}$$

Where: Dist = forebay length (m)

r = length-to-width ratio

Q_p = peak flow rate from the pond during design quality event (25 mm design storm event) (m^3/s)

V_s = settling velocity (m/s)

$$Dist = \sqrt{\frac{3(0.014)}{0.0003}}$$

Dist = 11.8 m

Dispersion Length

$$Dist = \frac{8Q}{dV_f}$$

Where: Dist = length of dispersion (m)

Q = inlet pipe capacity (10 year storm event) (m^3/s)

d = depth of permanent pool in the forebay (m)

V_f = desired velocity in the forebay (m/s)

$$Dist = \frac{8(1.571)}{1.3(0.5)}$$

Dist = 19.3 m

The proposed forebay length is 45 metres and is therefore greater than the required lengths for settling and dispersion.

Minimum Forebay Bottom Width

$$Width = \frac{Dist}{8}$$

$$Width = \frac{19.3}{8}$$

Width = 2.4 m

The proposed bottom width is 5.0 metres and is therefore greater than the required width.

4.1.3.2 Quantity Control

SWM Pond 3 discharges to the Simpson Municipal Drain. The peak flows comparing the post-development flows to the pre-development flows for each drain can be found in Section 4.1.8. The post-development controlled peak flow, storage volume, and depth above permanent pool for Pond 3 can be found in Table 9 below.

Table 9: Pond 3 - Quantity Control Results

Return Period	Post-Development Controlled Peak Flow (L/s)	Storage Volume (m^3)	Depth above Perm. Pool (m)
25 mm 4-hr	14	1,717	0.50
1:2 year	23	3,697	0.98
1:5 year	65	4,358	1.12
1:10 year	112	4,867	1.22
1:25 year	174	5,445	1.33
1:50 year	305	5,728	1.39
1:100 year	500	5,917	1.42

4.1.4 Pond 4A

4.1.4.1 Quality Control

SWM Pond 4A collects surface water runoff from the compost processing and storage pad. Pond 4a will be a two celled storage pond dedicated to receive runoff from the proposed compost pad area. One cell will be dedicated to receive runoff from final curing areas of the pad while the other will be for runoff from the remainder. This pond is sized to contain runoff equivalent to the 1:100 year, 24 hour event for the pad area, without discharge to off-Site surface water. The total drainage area is 4.2 ha (Drainage Area 202 on Figure 4). The stored water within the pond cells will be managed to maintain adequate capacity by re-using the water from the appropriate cell for compost pile spraying and Site irrigation. To ensure Site irrigation is a viable option, water quality samples from both cells of Pond 4a will be collected for analysis during the demonstration phase of the organics processing facility. Should water quality be such that Site irrigation is not possible, surplus water from Pond 4a would be taken to the City of Ottawa wastewater treatment plant with the pre-treated leachate/wastewater from the Site.

4.1.4.2 Quantity Control

SWMP Pond 4A does not drain off-site, therefore does not impact the overall peak flows back to the watershed. In Table 10 below, the peak flows are seen to be 0 L/s due to the process decribed in Section 4.1.4.1.
The amount of storage volume and depth above the permanent pool can be found below as a reference for the amount of water to be re-used.

Table 10: Pond 4a - Quantity Control Results

Return Period	Post-Development Controlled Peak Flow (L/s)	Storage Volume (m^3)	Depth (m)
25 mm 4-hr	0	801	0.69
1:2 year	0	1,942	1.31
1:5 year	0	2,613	1.60
1:10 year	0	3,239	1.84
1:25 year	0	3,898	2.07
1:50 year	0	4,389	2.22
1:100 year	0	4,890	2.37

4.1.5 Pond 4B

4.1.5.1 Quality Control

SWM Pond 4B collects surface water runoff from the east portion of the industrial portion of the Site. There are a series of ditches and culverts which collect surface water runoff from the organics processing facility primary reactor cells, the secondary digester and flare, and the leachate treatment building. The outlet structure is a 1050 mm diameter HDPE pipe with a 75 mm orifice at elevation 75.25 and a 250 mm orifice at elevation 76.05 which provides a 40-hour retention time for runoff produced by a 25 mm design storm. An overflow weir at elevation 76.60 m is also included. The 25 mm design storm hydrograph for Pond 4B is provided in Attachment A.3. The total drainage area is approximately 16.3 ha (Drainage Area 202 on Figure 4). SWM Pond 4B discharges to the Simpson Municipal Drain.

Table 3.2 of the MOE SWM Planning and Design Manual (2003) provides storage volume design requirements based on specific site imperviousness levels to achieve required TSS removal objectives. Table 3.2 indicates that the minimum storage volume should be based on 140 m^3/ha for Enhanced 80% long-term TSS removal and an impervious level of 65%. For an area of 16.30 ha, this results in a required storage volume of approximately 3,472 m^3, of which 40 m^3/ha required for extended detention and the remainder representing the permanent pool. The proposed pond provides a permanent pool storage volume of approximately 2,910 m^3 and an extended detention storage volume of 2,827m^3 exceeding the requirements 2,820 m^3 and of 652 m^3 for permanent pool and extended detention respectively.

The following table provides the design values for the wet pond and compares these values to the minimum or preferred criteria as per Table 4.6 of the MOECC Manual:

Table 11: Pond 4b – MOECC Design Criteria

Design Element	Design Value	Comparison to MOECC Criteria
Drainage Area	16.30 ha	Meets Preferred Criteria
Treatment Volume	Permanent Pool – 2,910 m^3 Active Storage – 2,827m^3	Exceeds Preferred Criteria
Forebay	Depth – 1.25 m Maximum Area – 21.4% of total area	Exceeds Minimum Criteria
Length-to-Width Ratio	Overall – 23.6:1 Forebay – 3.8:1	Exceeds Preferred Criteria
Permanent Pool Depth	Maximum Depth – 1.5 m Mean Depth – 1.38 m	Meets Preferred Criteria
Active Storage Depth	Water Quality and Erosion Control – 0.46 m Total Depth – 1.44 m	Exceeds Preferred Criteria
Side Slopes	4:1	Minimum 5:1 Safety Criteria Not Met (landfill site with restricted access)
Inlet	Ditch at 0.15%	Meets Minimum Criteria
Outlet	1050 mm dia. pipe with a 75 mm orifice at elevation 75.25 and a 250 mm orifice at elevation 76.05, 1.0% slope 10 m wide overflow weir at elevation 76.60	Meets Minimum Criteria

The following calculations summarize the design requirements of the forebay as per Section 4.6.2 of the MOECC Manual:

Forebay Settling Length

$$Dist = \sqrt{\frac{rQ_p}{V_s}}$$

Where: Dist = forebay length (m)

r = length-to-width ratio

Q_p = peak flow rate from the pond during design quality event (25 mm storm event) (m^3/s)

V_s = settling velocity (m/s)

$$Dist = \sqrt{\frac{3.8(0.008)}{0.0003}}$$

Dist = 10.1 m

Dispersion Length

$$Dist = \frac{8Q}{dV_f}$$

Where: Dist = length of dispersion (m)

Q = inlet pipe capacity (10 year storm event) (m^3/s)

d = depth of permanent pool in the forebay (m)

V_f = desired velocity in the forebay (m/s)

$$Dist = \frac{8(2.577)}{1.25(0.5)}$$

Dist = 33.0 m

The proposed forebay length is 56.2 metres and is therefore greater than the required lengths for settling and dispersion.

Minimum Forebay Bottom Width

$$Width = \frac{Dist}{8}$$

$$Width = \frac{33.0}{8}$$

Width = 4.1 m

The proposed bottom width is 6.0 metres and is therefore greater than the required width.

4.1.5.2 Quantity Control

SWM Pond 4B discharges to the Simpson Municipal Drain. The peak flows comparing the post-development flows to the pre-development flows for each drain can be found in Section 4.1.8. The post-development controlled peak flow, storage volume, and depth above permanent pool for Pond 4B can be found in Table 12 below.

Table 12: Pond 4B - Quantity Control Results

Return Period	Post-Development Controlled Peak Flow (L/s)	Storage Volume (m^3)	Depth above Perm. Pool (m)
25 mm 4-hr	8.0	2,827	0.46
1:2 year	36	6,224	0.96
1:5 year	76	7,519	1.13
1:10 year	100	8,875	1.31
1:25 year	318	9,481	1.38
1:50 year	585	9,679	1.41
1:100 year	950	9,896	1.44

4.1.6 Pond 5A

4.1.6.1 Quality Control

SWM Pond 5A collects surface water runoff from the northwest portion of the industrial portion of the Site. There are a series of ditches and culverts which collect surface water runoff from the drop-off area and C&D processing facility. SWM Pond 5A outlets to Pond 5B via three 600 mm diameter HDPE pipes. The total drainage area is approximately 14.74 ha (Drainage Area 101 on Figure 4). SWM Pond 5A discharges to the Regimbald Municipal Drain via SWM Pond 5B.

Table 3.2 of the MOE SWM Planning and Design Manual (2003) provides storage volume design requirements based on specific site imperviousness levels to achieve required TSS removal objectives. Table 3.2 indicates that the minimum storage volume should be based on 225 m^3/ha for Enhanced 80% long-term TSS removal and an impervious level of 70%. For an area of 14.74 ha, this results in a required storage volume of approximately 3,316 m^3, of which 40 m^3/ha required for extended detention and the remainder representing the permanent pool. The proposed pond provides a permanent pool storage volume of approximately 13,020 m^3 and an extended detention storage volume of 1,839m^3 exceeding the requirements of 2,726.9 m^3 and 590 m^3 for permanent pool and extended detention respectively.

The permanent pool will also be used for the fire protection system using a wet well and pump which distributes water to the sprinkler / standpipe systems at the C&D, MRF, Leachate Treatment and Organics Pre-Processing buildings. The details of the fire protection system are provided in the Site Servicing Report.

The following table provides the design values for the wet pond and compares these values to the minimum or preferred criteria as per Table 4.6 of the MOECC Manual:

Table 13: Pond 5A - MOECC Design Criteria

Design Element	Design Value	Comparison to MOECC Criteria
Drainage Area	14.74 ha	Meets Preferred Criteria
Treatment Volume	Permanent Pool – 13,020 m^3 Active Storage – 1,839m^3	Exceeds Preferred Criteria
Forebay	No forebay provided	Does not meet Criteria
Length-to-Width Ratio	Overall – 11.5:1	Exceeds Preferred Criteria
Permanent Pool Depth	Maximum Depth – 1.85 m Mean Depth – 1.85 m	Meets Preferred Criteria
Active Storage Depth	Water Quality and Erosion Control – 0.12 m Total Depth – 0.49 m	Exceeds Preferred Criteria
Side Slopes	4:1	Minimum 5:1 Safety Criteria Not Met (industrial and landfill site with restricted access)
Inlet	Ditch at 0.15% and 450 mm storm sewers at 0.30%	Does not meet Minimum Criteria (<1% slope on inlet pipes)
Outlet	3-600 mm dia. outlet pipe, 1.0% slope	Meets Minimum Criteria

4.1.6.2 Quantity Control

SWM Pond 5A discharges to the Regimbald Municipal Drain via SWM Pond 5B. The peak flows comparing the post-development flows to the pre-development flows for each drain can be found in Section 4.1.8. Since Pond 5A discharges to Pond 5B, only the storage volume, and depth above permanent pool are included in Table 14 below. The flow between the two ponds are controlled with three 600 mm HDPE culverts at the normal water level.

Table 14: Pond 5A - Quantity Control Results

Return Period	Storage Volume (m^3)	Depth above Perm. Pool (m)
25 mm 4-hr	1,839	0.12
1:2 year	3,879	0.24
1:5 year	4,928	0.30
1:10 year	5,942	0.36
1:25 year	6,976	0.42
1:50 year	7,676	0.46
1:100 year	8,366	0.49

4.1.7 Pond 5B

4.1.7.1 Quality Control

SWM Pond 5B collects surface water runoff from the northwest portion of the industrial portion of the Site. There are a series of ditches and culverts which collect surface water runoff from the drop-off area and C&D processing facility. SWM Pond 5B outlets via a900 mm diameter HDPE pipe with a 700 mm diameter orifice which provides a 160-hour retention time for runoff produced by a 25 mm design storm. The total drainage area is approximately 9.51 ha (Drainage Area 102 on Figure 4). SWM Pond 5B discharges to the Regimbald Municipal Drain.

Table 3.2 of the MOE SWM Planning and Design Manual (2003) provides storage volume design requirements based on specific site imperviousness levels to achieve required TSS removal objectives. Table 3.2 indicates that the minimum storage volume should be based on 225 m^3/ha for Enhanced 80% long-term TSS removal and an impervious level of 70%. For an area of 9.51 ha, this results in a required storage volume of approximately 2,140 m^3, of which 40 m^3/ha is required for extended detention and the remainder representing the permanent pool. The proposed pond provides a permanent pool storage volume of approximately 8,680 m^3 and an extended detention storage volume of 1,687m^3 exceeding the requirements of 1,759 m^3 and 380 m^3 for permanent pool and extended detention respectively.

The following table provides the design values for the wet pond and compares these values to the minimum or preferred criteria as per Table 4.6 of the MOECC Manual:

Table 15: Pond 5B - MOECC Design Criteria

Design Element	Design Value	Comparison to MOECC Criteria
Drainage Area	9.51 ha	Meets Preferred Criteria
Treatment Volume	Permanent Pool – 8,680 m^3 Active Storage – 1,687m^3	Exceeds Preferred Criteria
Forebay	No forebay provided	Does not meet Criteria
Length-to-Width Ratio	Overall – 11.5:1	Exceeds Preferred Criteria
Permanent Pool Depth	Maximum Depth – 1.9 m Mean Depth – 1.9 m	Meets Preferred Criteria
Active Storage Depth	Water Quality and Erosion Control – 0.12 m Total Depth – 0.49 m	Exceeds Preferred Criteria
Side Slopes	4:1	Minimum 5:1 Safety Criteria Not Met (industrial and landfill site with restricted access)
Inlet	3 - 600 mm culvert at 0.3% and 450 mm storm sewers at 0.30%	Does not meet Minimum Criteria (<1% slope on inlet pipes)
Outlet	900 mm dia. outlet pipe with 700 mm diameter orifice, 1.0% slope	Meets Minimum Criteria

4.1.7.2 Quantity Control

SWM Pond 5B discharges to the Regimbald Municipal Drain. The peak flows comparing the post-development flows to the pre-development flows for each drain can be found in Section 4.1.8. The post-development controlled peak flow, storage volume, and depth above permanent pool for Pond 5B can be found in Table 16 below.

Table 16: Pond 5B - Quantity Control Results

Return Period	Post-Development Controlled Peak Flow (L/s)	Storage Volume (m^3)	Depth above Perm. Pool (m)
25 mm 4-hr	10	1,687	0.12
1:2 year	39	3,534	0.24
1:5 year	73	4,469	0.30
1:10 year	201	5,369	0.36
1:25 year	255	6,277	0.42
1:50 year	293	6,885	0.46
1:100 year	330	7,476	0.49

4.1.8 Predicted Effects on On-Site Flows

The ditches within the Site are designed to convey stormwater to the SWM Ponds, or eastern Site boundary culverts directly, as shown in engineered drawing package. Three types of channels (ditch, SWM Pond inlet, or outfall channels and spillways) have been designed considering the slope along with the peak flow and corresponding velocity computed for a 1 in 25 year design storm. Based on the functionality of the channels, with consideration of peak velocity results, these conveyance features have been designed with two types of surface treatment: rip-rap lined, or vegetated ditches. Conveyance channel design details are outlined in Section 4.2.

Post-closure conditions are used for the surface water quantity assessment as the entire Site will be contributing to Site runoff when the landfill component has been capped. In order to minimize potential for nuisance flooding during minor storm events, and property damage during major events, the ponds have been designed for the 1:100 year storm event.

Peak flow rates were extracted from the SWMM5 model for pre- and post-development conditions. Under the post-development scenario, the increase in respective impervious land use and average slopes for the sub-catchment areas are expected to generate increased runoff conditions. Peak flow rates were extracted from the SWMM5 model for the 6-hour Historical storm to be used as a comparison measure against the other drains. Due to the nature of the historical storm, the peak flows were under the 100-year flow rates.

The model identified that the calculated post-development un-mitigated peak flows at all Site outlet locations exceeded pre-development peak flow conditions. The model was then updated to include SWM Ponds (storage reservoirs). Table 17 below compares the pre-development and controlled, post-development peak flows for each Site sub-catchment area.

Table 17: Pre- and Post-Development Peak Flow Rates Comparison

Municipal Drain Sub-Catchment		Drainage Areas (ha)		Peak Discharge to Municipal Drains (L/s)											
				1:2yr		1:5yr		1:10yr		1:25yr		1:50yr		1:100yr	
		Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post
1	Regimbald	21	24.3	86	39	298	73	375	201	471	255	535	293	556	330
2	Simpson	75.6	83.8	35	32	284	77	406	232	585	379	732	458	899	674
3	Wilson-Johnston	95.1	83.6	40	34	345	129	495	256	715	569	898	819	1106	1099

These SWMM5 peak flows, generated from local IDF curves over a 24 hour period using the SCS type II distribution, are conservative for the purposes of recommending the approximate SWM Pond sizes to meet storage volume requirements to manage peak flows without flooding (James, 2003).

4.2 Conveyance Channels

The ditches within the Site are designed to convey stormwater to the SWM Ponds, or eastern Site boundary culverts directly, as shown on Grading and Drainage Plans GD1 and GD2.

The three types of channels (ditch, SWM Pond inlet or outfall channels, and spillways) have been designed, considering the slope, along with the peak flow and corresponding velocity computed for a 1 in 25 year design storm. Based on the functionality of the channels, with consideration of peak velocity results, these conveyance features have been prescribed with two types of surface treatment: rip-rap lined, or vegetated ditches.

Summaries of both types of ditches, along with the rip-rap lining and associated geotextile fabric specifications for a few prescribed locations at the outlets of the conveyance features are outlined below. Typical details and slopes for channels are provided on Design Drawings.

Landfill Perimeter Vegetated Ditches

The perimeter ditches around the landfill boundaries are proposed to be grass lined. These perimeter ditches will be trapezoidal with a 0.5 metre bottom width, a 7H:1V sideslope on the landfill side and a 3H:1V sideslope on the outer side. Slopes will be approximately 0.30%, respecting the proposed topography, and will have a minimum depth of 0.5 metres.

Interior Ditches – Facility Operations Area

Most of the interior ditches will be trapezoidal with a 1.0 metre bottom width, 4H:1V side slopes, and will have a maximum depth of 0.5 metres. There will also be some v-notch ditches where flows are low and there are space constraints. The longitudinal slopes of these ditches vary with a minimum of 0.15%, respecting the existing topography.

Inlet, Outlet and Spillway Channels with Rip-Rap Lining

Pond inlet conveyance channels, overflow spillways or outfall channels experience high erosive forces.
To provide effective energy dissipation and minimize erosion potential from the 1 in 25 year design storm, and any larger major events (e.g. 1 in 100 year storm), it is proposed these channels be lined with rip-rap and annual maintenance and repair practices be followed.

The thickness of the rip-rap layer is to be a minimum of 1.5 times the rip-rap nominal diameter. The mean diameter for the rip-rap stone was selected to have nominal diameter of 200 millimetres.

Geotextile Fabric

A geotextile fabric will be required beneath rip-rap areas and is recommended to be extended three to five channel widths downstream to mitigate any scour potential. The fabric is required to be “keyed in” 200 mm from the crest of the ditch as indicated in the Ontario Provincial Standard Drawing 219.211 (MTO, 2006).

4.3 Culvert Design

All of the culverts on-Site have been designed to convey the 1 in 25 year, 24 hour storm event and will be located beneath existing roadways. Minimum culvert diameter will be 600 millimetres.

There are two road crossings of the Simpson drain to the landfill. Each will require a 1500 mm diameter culvert which has been sized to accommodate the 1 in 100 year, 24 hour storm event from the upstream area of 83.8 ha.

4.4 Storm Sewers

All of the storm sewers on-Site have been designed to convey the 1 in 2 year storm event and will be located beneath existing asphalt and roadways. For storms larger than the 1 in 2 year storm event surface water will be conveyed overland via the paved surfaces to the stormwater management ponds. The C&D and MRF building will have downspouts for stormwater from the roof to be collected and brought to SWM Pond 5A and 5B respectively. The roof downspouts are directed via sewers instead of discharging to the asphalt to avoid potential ice buildup in the winter months. The downspouts will incorporate an overflow just above the exterior ground elevation. Surcharging of the sewers and overflow during events greater than the 1 in 2 year event are likely to only occur during the warmer periods when ice build-up is not an issue. The compost pad will have catchbasins within the asphalt surface to collect surface water and a series of storm sewers to convey the water to SWM Pond 4A. The drainage and grading of the compost pad is such that there is capacity on the pad for temporary surface storage in the event that the sewers are unable to convey all of the flow, without overflowing the pad and draining to other areas of the Site.

5.0 MONITORING, OPERATION AND MAINTENANCE

The inspection of E&SC measures during construction should occur on a weekly basis, at minimum. E&SC inspection during construction should also occur after significant rainfall events (e.g., greater than approximately 10 mm). An inspection report, highlighting any E&SC deficiencies, should be prepared for each inspection and kept on-Site for reference and reporting purposes, if needed (GGHA CAs, 2006).

Visual inspections of SWM or water conveyance features should be performed post-construction on a quarterly (seasonal) basis to ensure sediment build-up has not caused any conveyance capacity issues or potential for an increase in TSS loadings transported downstream. During rainfall-runoff events, visual observations will continue to support the post-development runoff assessment and the successful performance of the SWM Ponds in meeting Enhanced Level of treatment (MOE, 2003).

At minimum, the following should be observed during inspections:

- Signs of erosion of the SWM structures. This is important particularly before the re-vegetation cover has been established;
- Sediment build-up in the swales. For any retention controls (i.e., rock check dams, sediment traps), sediment build-up can be expected at the upstream end of these structures and therefore the stormwater conveyance channels should be inspected on a regular basis and cleaned out periodically to avoid sediment deposits being transported off-Site. Clean-out is recommended to occur once sediment accumulation is clearly visible (GGHA CAs, 2006). In practical terms, clean-out of the rock check dams is recommended if the build-up is greater than one-half the height, from the toe to the spillway. Sediment should be removed in a matter that avoids escape of the sediment downstream and that avoids damage to the control structure. Sediment should be removed to the level of the grade existing at the time the control structure was constructed;
- Ponding in the swales or sediment traps; and,
- Silt fencing. All silt fences used for E&SC should meet required minimum height of 0.6 m. They should be repaired or replaced if damaged.

Environmental monitoring related to surface water at the CRRRC will be carried out concurrently with the overall Site monitoring program. As such, reference should be made to the overall facility D&O report for monitoring, trigger mechanisms and contingency measures related to surface water, sediment and biology.

6.0 SEDIMENT AND EROSION CONTROL

The following sections summarizes the Erosion and Sediment Control (ESC) Plan measures for the proposed Capital Region Resource Recovery Centre (CRRRC) as per commitments 42, 44, 48, 53, 55 and 57 of the Environmental Assessment Study Report.

6.1 General Considerations

- The ESC measures will be according to the future permits and approval requirements issued by regulatory and authority bodies (Ministry of Environment and Climate Change/South Nation Conservation Authority). A copy of the permit conditions and the ESC Plan will be maintained on-site at all times during construction and operation.
- Contractor staff will be familiar with the ESC measures and be aware of the existing and proposed measures as outlined in this memorandum.
- The ESC measures will be installed upstream of the stormwater outlets where the runoff drains into existing municipal drains.
- Accumulated sediment will be removed on a regular basis, and as needed, to ensure the proper operation and maintenance of the ESC measures as intended. The accumulated sediment and debris should be removed prior to the removal of the ESC measures.
- The maintenance and refueling of the machinery on-site should be limited to the areas with a minimum of 30 metre distance away from the ditches, drains and outlets that facilitate stormwater conveyance.
- The unloading of the construction materials and soil stockpiling will be performed in areas with at least a 30 metre distance from the ESC measures and ditches, drains and outlets that facilitate stormwater conveyance.
- All work along the Simpson Municipal Drain and existing drain outlets will only be done during dry weather. Weather forecasts will be monitored by contractors and construction scheduled accordingly.

6.2 Cover Vegetation

A major focus for control of sediments is to minimize the erosion potential.

- The existing vegetation cover will be removed progressively in sequence with the site development to minimize the area of removed vegetation during construction.
- Best management practices for erosion control, as described below, will be used until the vegetation cover is re-established.
- Any soil stockpiles that are left in place for prolonged periods of time will be seeded to establish vegetation.
- Until vegetation is established, an erosion control blanket may be utilized and placed over the seeded areas, depending on the site location.

6.3 Grading and Soil Stockpiles

- The extent of disturbed areas and soil stockpiles (and the stockpile orientation with respect to prevailing wind directions) will be limited, as practical.

- To provide separation and assist in potential impacts from surface erosion, stockpiled materials will not be placed closer than 30 metres from ESC measures.
- Surface drainage will be inspected visually during construction to provide temporary grading such that runoff is directed towards suitable outlets.

6.4 Silt Fence and Straw Bale Barriers

- Prior to regrading the existing soil or placement of new soil materials on the north and/or south sides of the Simpson Drain, silt fence barriers will be installed adjacent to the Simpson Drain, on both the northern and southern sides of the buffer strip, to protect the watercourse from sediments entering the drain. The type of silt fence geotextile and number of tiers (layers) required for each sub-catchment area will be selected as part of the Final ESC design and included in the SNC work permit application.
- Silt fence tiers will also be installed around the perimeter of the site, where there are existing roadside ditches that facilitate drainage. The silt fence will be positioned adjacent to the side of the ditch within the site limits. The fence should extend to the final outlets to the north and south to control the amount of sediments that enter the outlets and ensure these ditches will not be blocked by the accumulated debris.
- To the extent possible, the silt fences should be installed perpendicular to the water runoff direction.
- Prior to filling the on-site ditches that outlet to the Regimbald and Wilson-Johnston Drains and any earthwork adjacent to these drains, straw bale barriers will be installed upstream of the existing culverts under Frontier Road.
- The silt fence and straw bale barriers installed along the perimeters of the site where a drainage ditch exists will remain in place until vegetation cover is re-established.

6.5 Rock Check Dams

- Rock check dams (150 mm D_{50} stone) are proposed upstream of the Regimbald and Wilson-Johnston culverts that convey drainage under Frontier Road to east of the site. These rock checks dams would be downstream of the above mentioned straw bale barriers.
- The height and width of the check dams will be determined as appropriate for the specific entrance channel/area and culvert. The width of the check dams will not be less than the opening of each respective culvert.

6.6 Settling Basin / Dewatering Trap

- For cut operations in areas with high groundwater level at the time of excavation, the excavation area will be pumped and water will be discharged directly to a temporary treatment train consisting of a siltation bag and/or sedimentation pond or dewatering trap.
- The location of the treatment train is expected to shift as construction proceeds in various areas of the site. The treated discharge from the dewatering trap will sheet flow toward the outlets.

6.7 Inspection and Maintenance

- The ESC measures will be inspected on a daily basis by Contractor personnel.
- Any maintenance, including the removal of accumulated sediment will be carried out as required.
- The water removed from dewatering of accumulated sediments will also be directed to a sedimentation pond or dewatering traps.
- Any catch basins and maintenance holes will be temporarily protected by berms and/or covers to control the amount of sediments entering the storm sewers.

6.8 Works Within the Simpson Drain

- Work within the Simpson Municipal Drain will only be done during dry weather. Weather forecasts will be monitored by the Contractor and construction scheduled accordingly.
- Due to the low gradient of the drain, even during dry weather there will likely be a small base flow or ponded water within the drain. Temporary cofferdams may need to be installed to isolate the work area so that the work can be done in the dry. Water accumulation / flow in the drain would be temporarily managed, as required, by pumping from upstream to downstream of the work area.
- Straw bale barriers and/or other silt control barriers will be installed directly downstream of the location of the two new culverts prior to installation. Rip-rap will be installed at the inlet and outlet of the culverts as per OPSS 511 and OPSD 810.010, underlain with geotextile including the drain side slopes.
- The installation of the two additional service crossings for the leachate and landfill gas conveyance pipes will be installed via open cut across the drain. Temporary cofferdams and silt control barriers will be used to isolate the work area. The excavation will need to be kept dry and will include a dewatering pump with discharge to a sedimentation pond or similar silt removal system, as mentioned above. If it is anticipated that the duration of the installation work will result in excessive build-up of water upstream of the cofferdam, a temporary bypass system may also need to be installed to pump base flow in the Simpson Drain around the work area.

7.0 EROSION AND SEDIMENT CONTROL PLAN – OPERATIONS

- Where cover vegetation is not established, erosion control blankets or other erosion control measures such as diversion berms will be used on new external landfill slopes.
- The Simpson Drain will be protected by a buffer zone adjacent to both the north and south sides of the drain. No construction or landfill operation will be carried out within 10 metres from the drain.
- The two proposed culverts in the Simpson Drain under the proposed access roads will be inspected and maintained on a regular basis, as required.
- The reinstated roadside ditches will be separated by the perimeter vegetated strip from active landfill operation on-site, and additional temporary or permanent ESC measures, i.e., silt fencing will be implemented adjacent to these ditches as and if required.
- A tire wash facility will be located on-site to reduce transport of material on truck tires from the landfill area. Similarly, the majority of access roads and traffic areas north of the Simpson Drain will be paved to minimize dust potential and subsequent transport of fines via runoff

Signature Page

We trust that this report meets your current needs. If you have any questions, or if we may be of further assistance, please contact the undersigned.

GOLDER ASSOCIATES LTD.

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June 15/18
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Senior Civil Engineer, Associate

MHK/DVK/mvrd
https://golderassociates.sharepoint.com/sites/18733g/technical work/phase 500 detailed design/task 5.1 civil engineering/swm report/1787048-001-r-revb-crrrc swm-11june2018.docx

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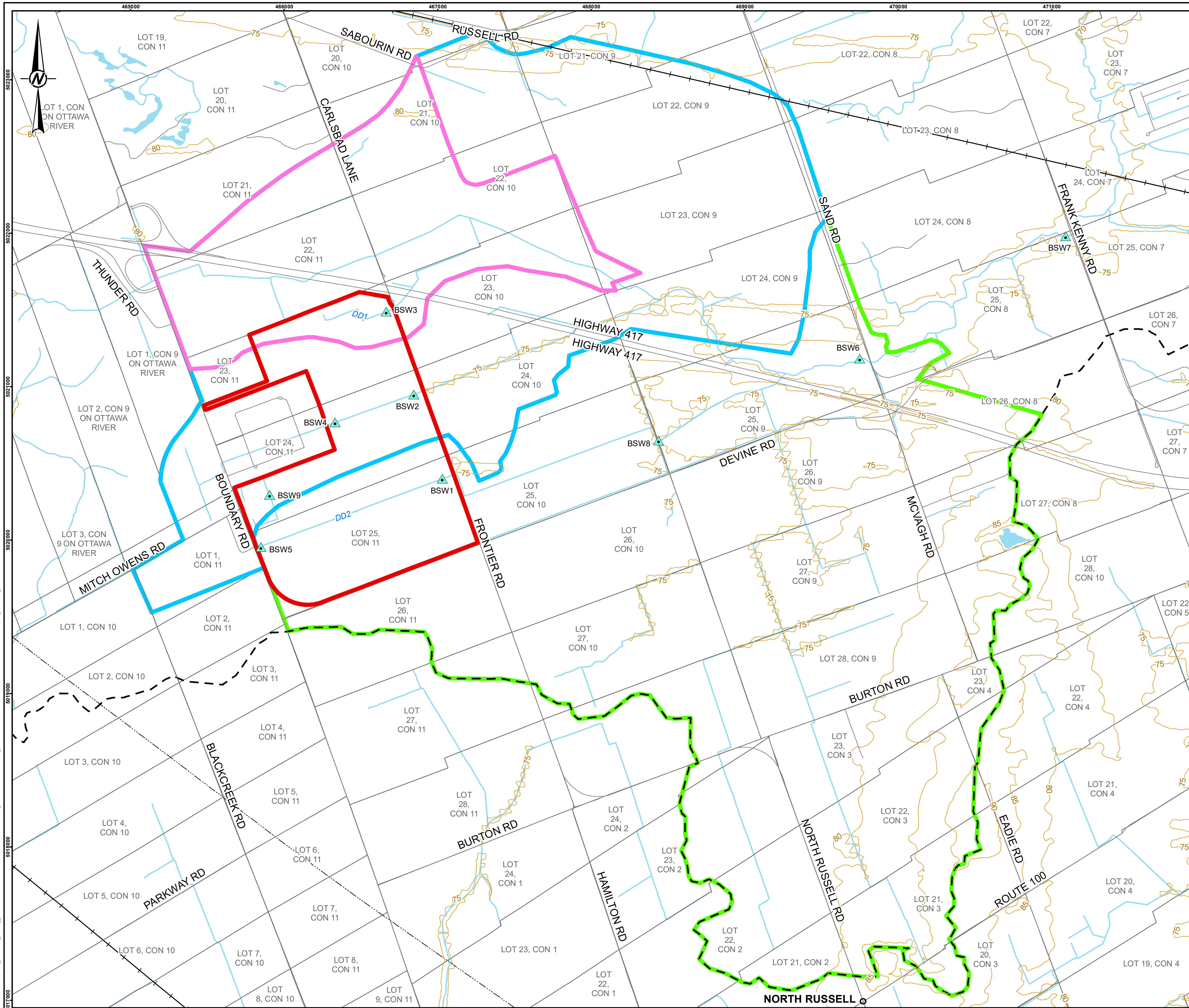
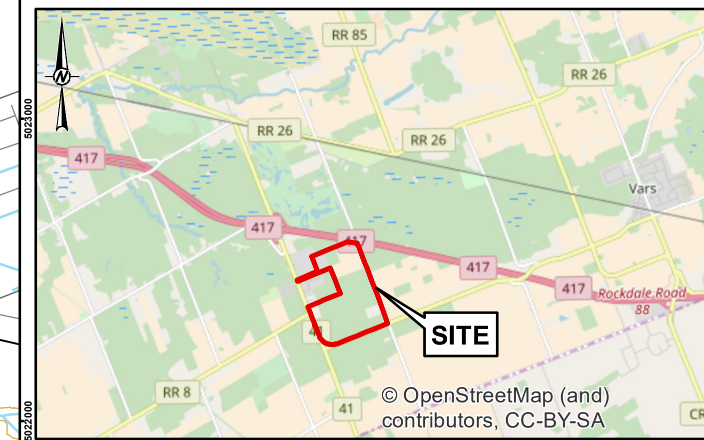


KEY MAP



SCALE 1:150,000

LEGEND

- POPULATED PLACENAME
- SURFACE WATER SAMPLING STATION
- ROAD
- RAIL ROAD
- CONTOUR LINE, (5m)
- UTILITY LINE
- REGIMBALD MUNICIPAL DRAIN BOUNDARY
- SIMPSON MUNICIPAL DRAIN BOUNDARY
- WILSON-JOHNSTON MUNICIPAL DRAIN BOUNDARY
- SURFACE WATER FEATURE
- WATER AREA
- SUBWATERSHED DIVIDE
- LOT/CONCESSION
- PROPERTY BOUNDARY

NOTE(S)
1. ALL LOCATIONS ARE APPROXIMATE

REFERENCE(S)
1. LAND INFORMATION ONTARIO (LIO) DATA PRODUCED BY GOLDER ASSOCIATES LTD. UNDER LICENCE FROM ONTARIO MINISTRY OF NATURAL RESOURCES, © QUEENS PRINTER 2012.
2. PROJECTION: TRANSVERSE MERCATOR DATUM: NAD 83 COORDINATE SYSTEM: UTM ZONE 18

0 250 500 1,000
1:25,000 METRES

CLIENT
TAGGART MILLER ENVIRONMENTAL SERVICES

PROJECT
CAPITAL REGION RESOURCE RECOVERY CENTRE

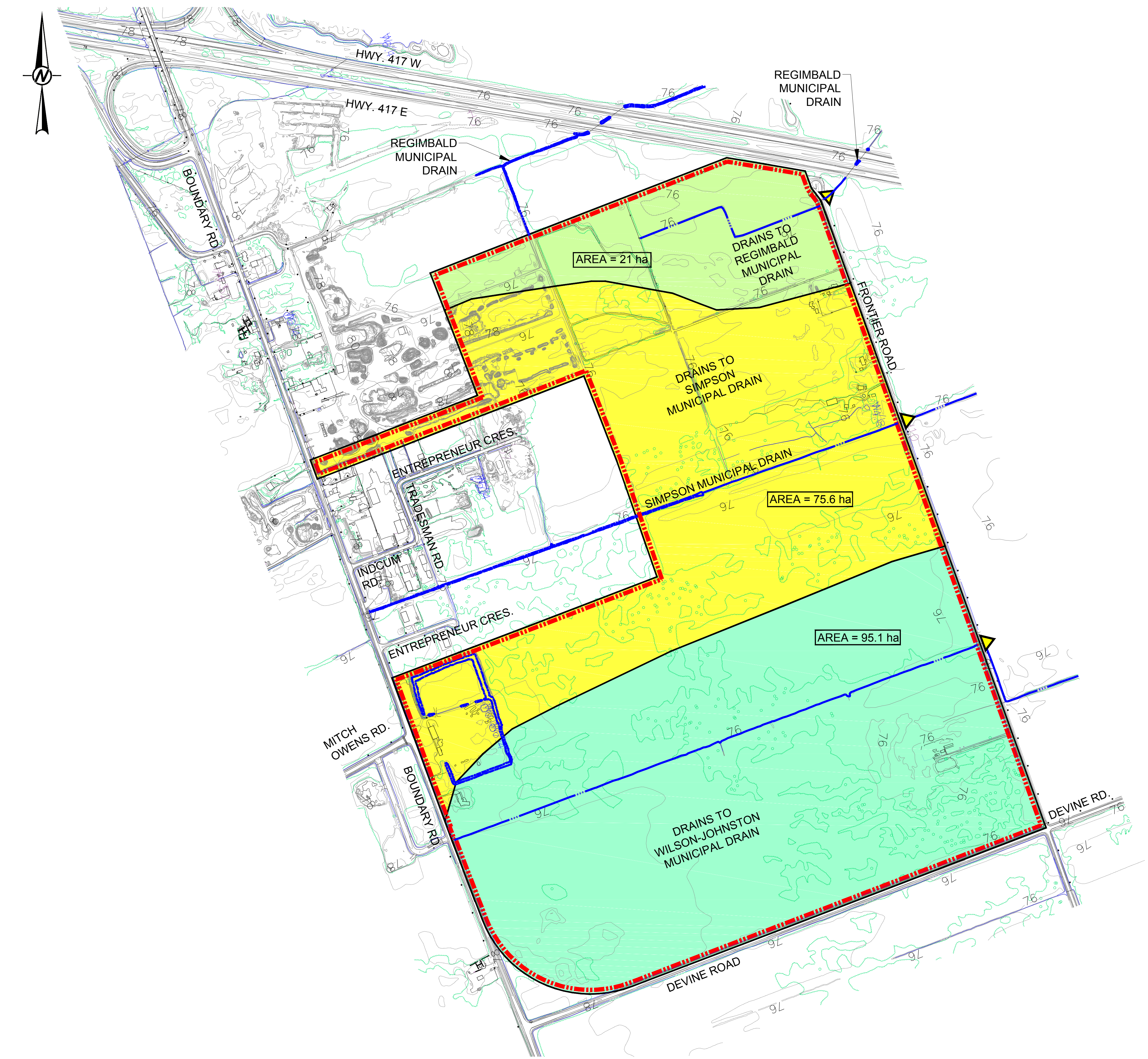
TITLE
KEY PLAN AND SURFACE WATER FEATURES

CONSULTANT
GOLDER

YYYY-MM-DD	2014-07-21
DESIGNED	JPAO
PREPARED	BR
REVIEWED	PLE
APPROVED	PAS

PROJECT NO.	CONTROL	REV.	FIGURE
12-1125-0045	4000	0	1

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: 25mm



LEGEND

- PROPERTY BOUNDARY
- SURFACE WATER
- OUTLET
- DRAINAGE AREA BOUNDARY

REFERENCE(S)

1. BASE DRAWING PROVIDED IN A DIGITAL FORMAT BY BASE MAPPING CO. LTD., CONTRACT NO. 2517-12, PHOTO DATE: NOVEMBER 7, 2012, DATE RECEIVED: JANUARY 9, 2013.
2. PROJECTION: TRANSVERSE MERCATOR DATUM: NAD 83 COORDINATE SYSTEM: UTM ZONE 18.
3. MUNICIPAL DRAIN BOUNDARIES FROM TOWNSHIP OF CUMBERLAND MUNICIPAL DRAIN & MUTUAL AGREEMENT PREPARED BY STANTEC, REVISED MARCH 2000.

0 250 500
1:10,000 METRES

CLIENT
TAGGART MILLER ENVIRONMENTAL SERVICES

PROJECT
CAPITAL REGION RESOURCES RECOVERY CENTRE

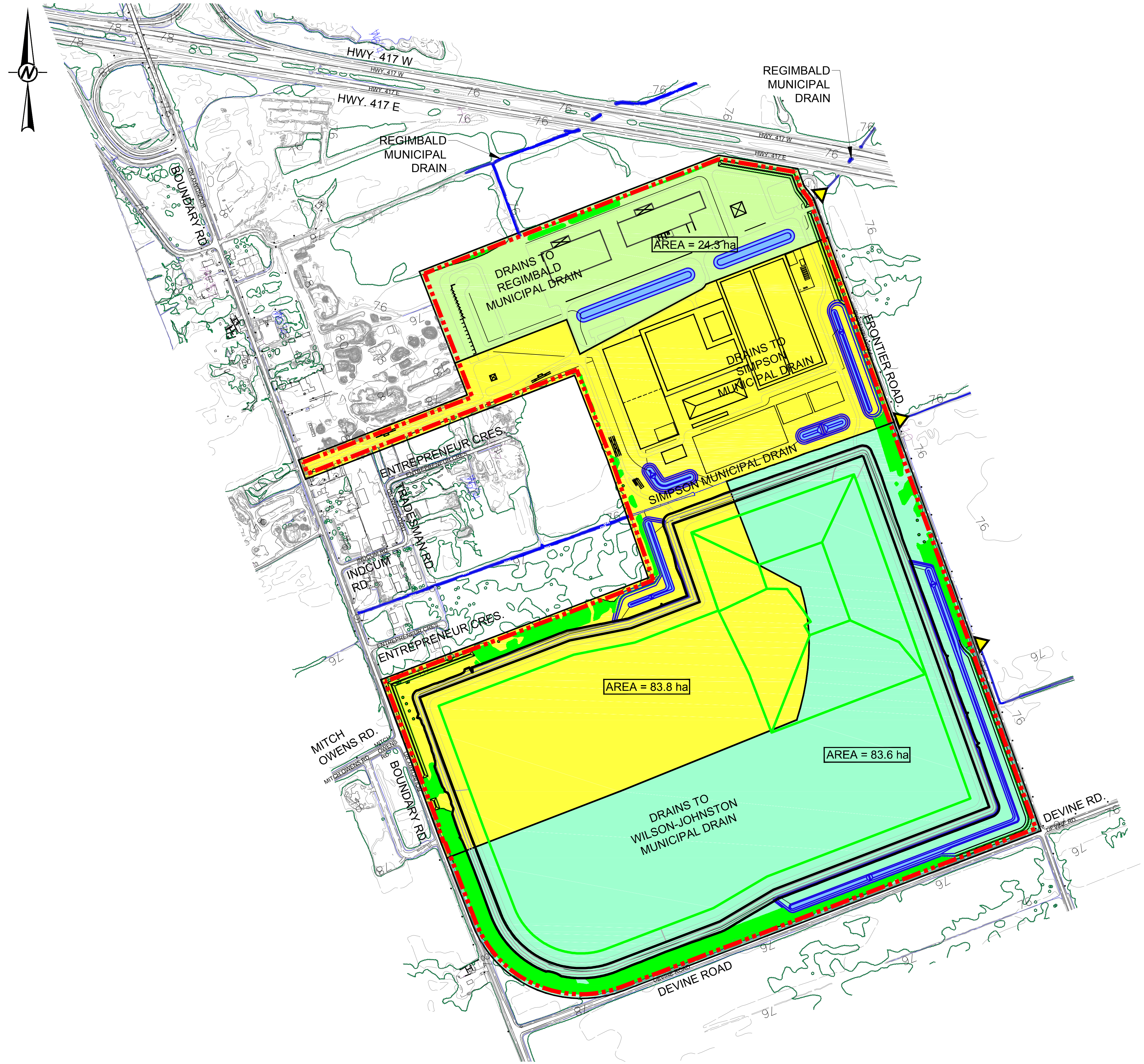
TITLE
PRE-DEVELOPMENT DRAINAGE AREAS

CONSULTANT

GOLDER

YYYY-MM-DD	2016-06-06
DESIGNED	M.L.F.
PREPARED	D.H.
REVIEWED	D.V.K.
APPROVED	P.A.S.

PROJECT NO.	PHASE	REV.	FIGURE
1787048	4000	0	2



LEGEND

(red dash-dot line)	PROPERTY BOUNDARY
(blue line)	SURFACE WATER
(yellow triangle)	OUTLET
(black line)	DRAINAGE AREA BOUNDARY

REFERENCE(S)

1. BASE DRAWING PROVIDED IN A DIGITAL FORMAT BY BASE MAPPING CO. LTD., CONTRACT NO. 2517-12, PHOTO DATE: NOVEMBER 7, 2012, DATE RECEIVED: JANUARY 9, 2013.
2. PROJECTION: TRANSVERSE MERCATOR DATUM: NAD 83 COORDINATE SYSTEM: UTM ZONE 18

0 250 500

1:10,000 METRES

CLIENT
TAGGART MILLER ENVIRONMENTAL SERVICES

PROJECT
CAPITAL REGION RESOURCES RECOVERY CENTRE

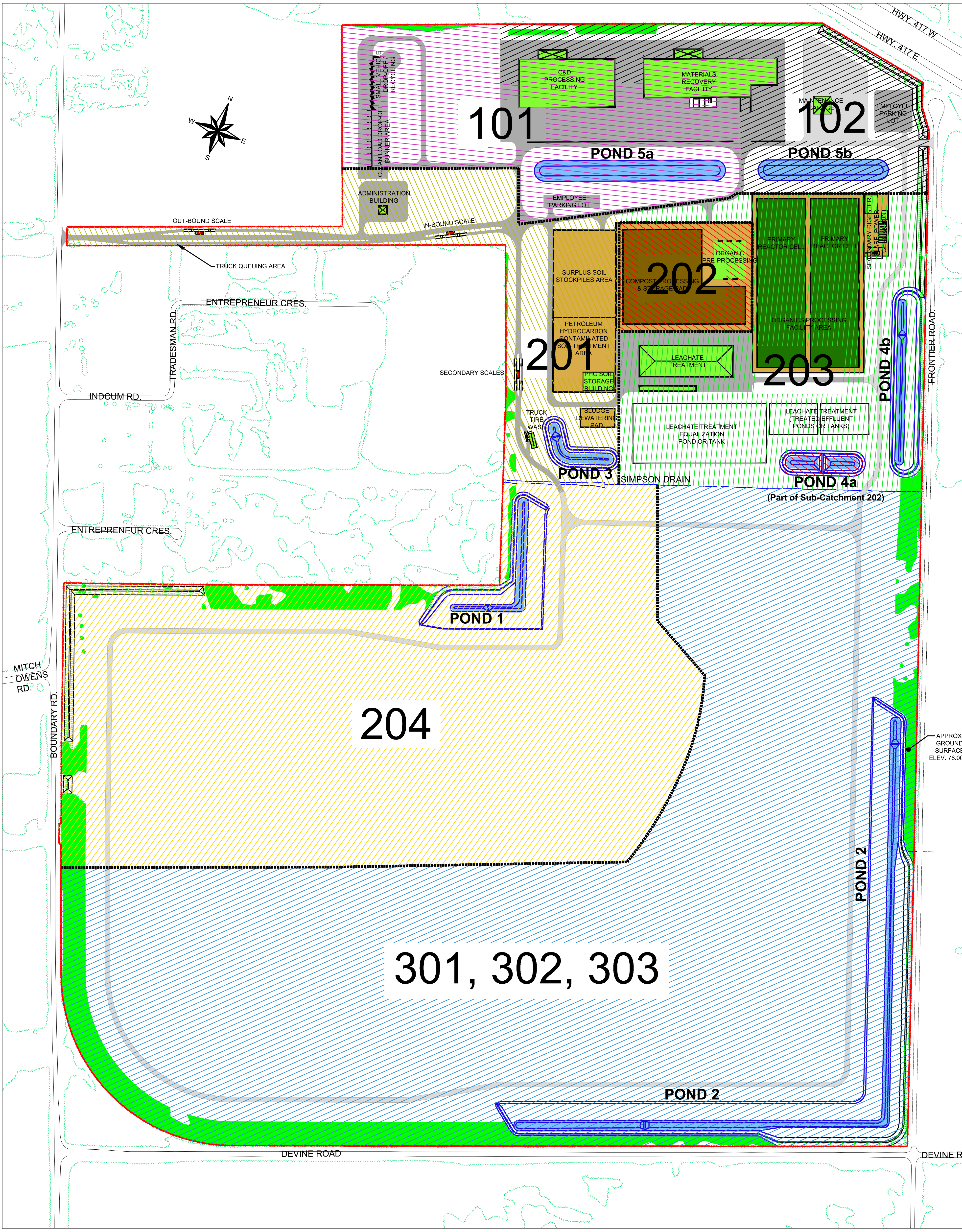
TITLE
POST-DEVELOPMENT DRAINAGE AREAS

CONSULTANT

GOLDER

YYYY-MM-DD	2018-06-06
DESIGNED	M.L.F.
PREPARED	D.H.
REVIEWED	D.V.K.
APPROVED	P.A.S.

PROJECT NO.	PHASE	REV.	FIGURE
1787048	4000	0	3



LEGEND

- FACILITY BUILDINGS
- OUTDOOR DIVERSION AREA
- PAVED ROAD (ASPHALT)
- GRAVEL ROAD
- PROPERTY BOUNDARY
- EXISTING VEGETATION SCREENING
- CONSTRUCTED SCREENING FEATURE
- PERIMETER BERM CONTOURS (interval 1 m)
- STORMWATER MANAGEMENT PONDS
- 203 SUB-CATCHMENT AREA NUMBER

0 250 500
1:10,000 METRES

CLIENT
TAGGART MILLER ENVIRONMENTAL SERVICES

PROJECT
CAPITAL REGION RESOURCES RECOVERY CENTRE

CONSULTANT
GOLDER

YYYY-MM-DD	2018-06-06
DESIGNED	M.L.F.
PREPARED	M.L.F
REVIEWED	D.V.K
APPROVED	P.A.S.

TITLE
SUB-CATCHMENT PLAN

PROJECT NO.	PHASE	REV.	FIGURE
1787048	4000	0	4

ATTACHMENT A.1

SWM Model Development

A.1 Hydrologic Model Input Summary Tables

1.0 HYDROLOGICAL PARAMETER SELECTION

The existing Site condition were determined to have five significant land use types: Scrubland; Woods; Pavement; Gravel; and Grasslands. The Manning's n coefficient, depression storage depth and SCS Curve Number values assigned for each of these land use types are summarized in Table A.1.2.

In addition to the five significant land use types identifies for the pre-development scenario, Vegetated Slope, and ravel land use types have also been incorporated into the post-development input parameters identified for each land use type.

Tables A.1.1 to A.1.5 summarize the pre-development and post-development hydrological input parameters for representing the Site conditions. Subsurface investigations performed by Golder were also utilized to identify the general silty sand soil type parameters such as the curve number, depression storage, Manning's n coefficient and the land use. These parameters were defined based on published literature values and Site investigations.

2.0 HYDROLOGIC MODEL INPUT SUMMARY TABLES

Table A.1.1: 24-hour Rainfall at City of Ottawa, CDA RCS Weather Station

Return Period (yrs)	Rainfall Depth (mm)
2	33.0
5	72.1
10	87.6
25	103.9
50	115.8
100	128.1

Note: The total depths were distributed over a 24-hour time period using 15-minute intensity intervals and a SCS Type II rainfall distribution.

Table A.1.2: Pre-Development Land Use Hydrologic Input Parameters

	Scrubland	Woods	Paved Road	Gravel	Grassland
Manning's n	0.15	0.4	0.012	0.024	0.035
Depression Storage (mm)	5	8	2	2	4
SCS Curve Number	77	70	98	89	71

Table A.1.3: Post-Development Land Use Hydrologic Input Parameters

	Scrubland	Woods	Paved Road	Gravel	Grassland	Landfill Slope
Manning's n	0.15	0.4	0.012	0.024	0.035	0.013
Depression Storage (mm)	5	8	2	2	4	5
SCS Curve Number	77	70	98	89	71	82

Table A.1.4: Pre-Development Sub-Catchment Hydrologic Input Parameters

Sub-Catchment	Area (ha)	Width (m)	Slope (%)	Impervious (%)	N Pervious	Dep. Stor. Pervious (mm)	Curve Number
E101	21.0	200	0.1	10	0.133	4	86.8
E201	42.3	220	0.125	7.5	0.165	4	85.1
E202	33.3	150	0.343	0	0.213	6	76.7
E301	95.1	250	0.167	7.5	0.184	5	80.6

Table A.1.5: Post-Development Sub-Catchment Hydrologic Input Parameters

Sub-Catchment	Area (ha)	Width (m)	Slope (%)	Impervious (%)	N Pervious	Dep. Stor. Pervious (mm)	Curve Number
P101	14.74	125	0.05	70	0.012	5	88.9
P102	9.51	125	0.076	70	0.012	5	88.9
P201	12.6	250	0.4	75	0.012	4	91.9
P202	4.2	100	0.5	90	0.012	4	95.3
P203	16.34	250	0.4	75	0.012	4	91.9
P204	48.2	640	4.3	0	0.012	5	79.0
P301	41.8	670	4.2	0	0.012	5	72.6
P302	27.9	430	4.2	0	0.012	5	72.6
P303	13.94	300	5.4	0	0.012	5	72.6

Note: Leachate Treatment Ponds (1.9ha Equalization Pond and 0.66ha Effluent Pond) are not included in the P203 Drainage Area

ATTACHMENT A.2

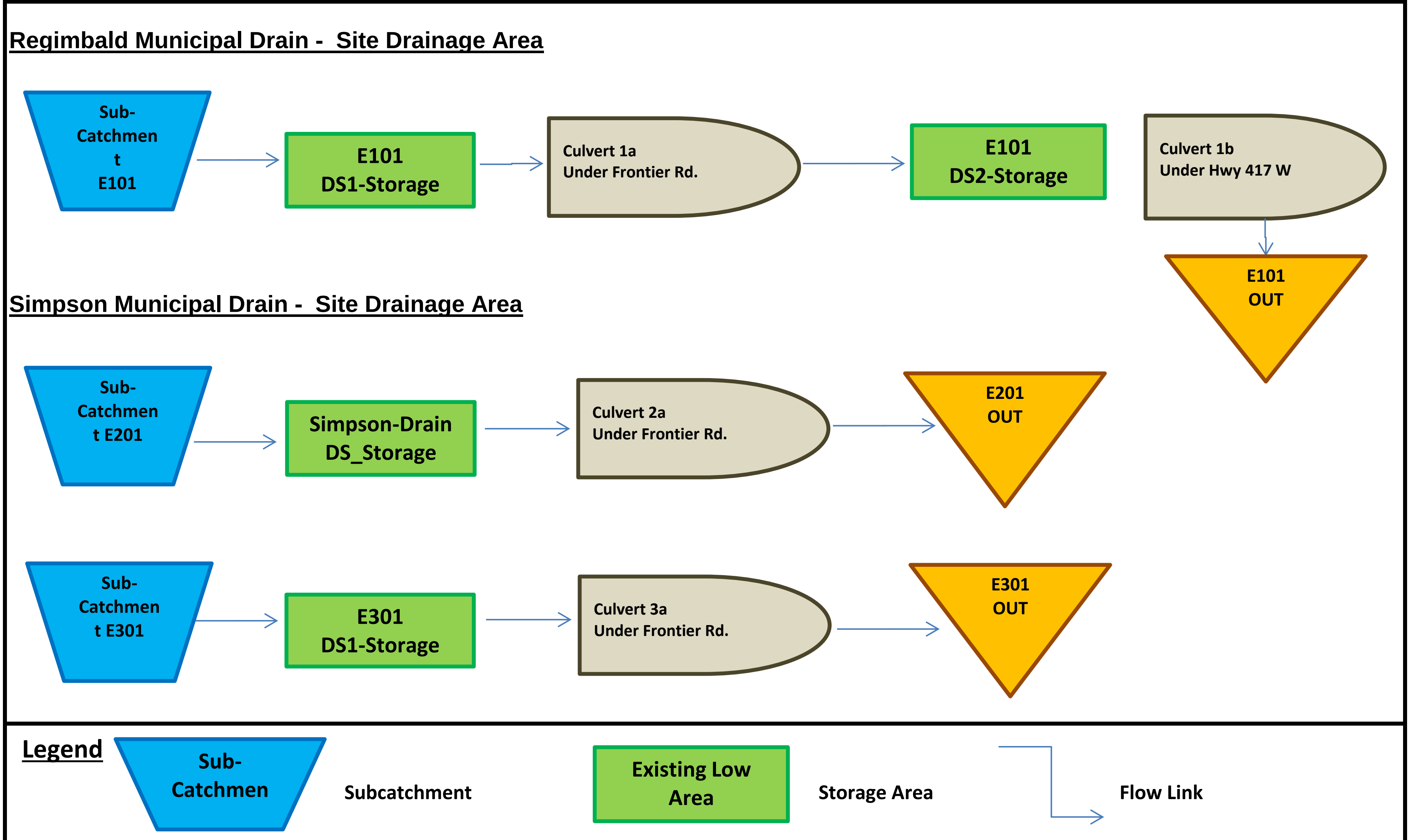
Existing and Proposed SWMM5 Schematics

Figures:

Figure A-1 – Existing Scenario SWMM5 Schematic

Figure A-2 – Proposed Scenario SWMM5 Schematic

Figure A-1: Existing Scenario SWMM5 Schematic

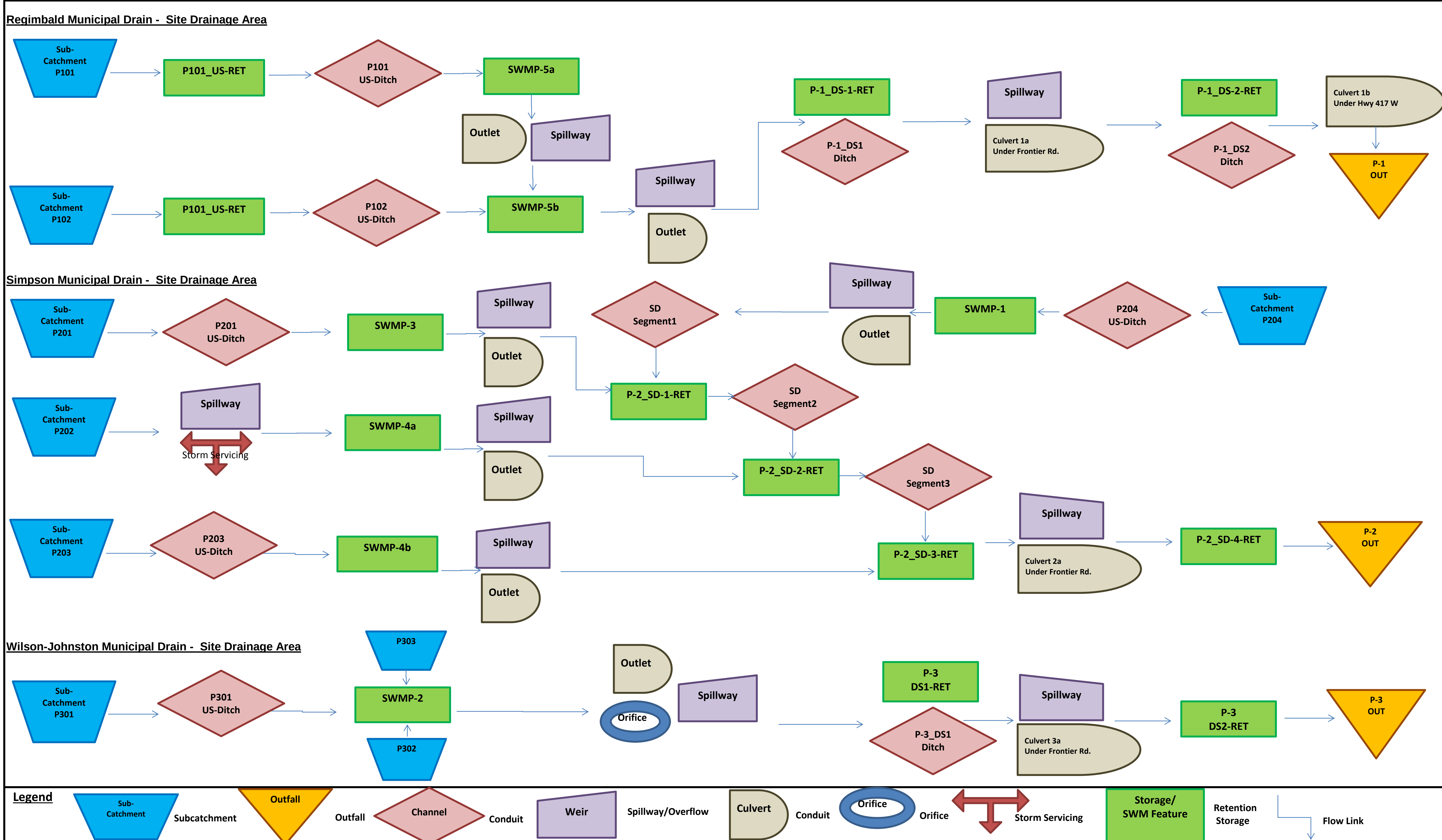


PROJECT: 1787048
DATE: June 2018

GOLDER

DRAWN: JSA
CHECK: TL

Figure A-2: Proposed Scenario SWMM5 Schematic



PROJECT: 1787048
DATE: June 2018

GOLDER

DRAWN: JSA
CHECK: TL

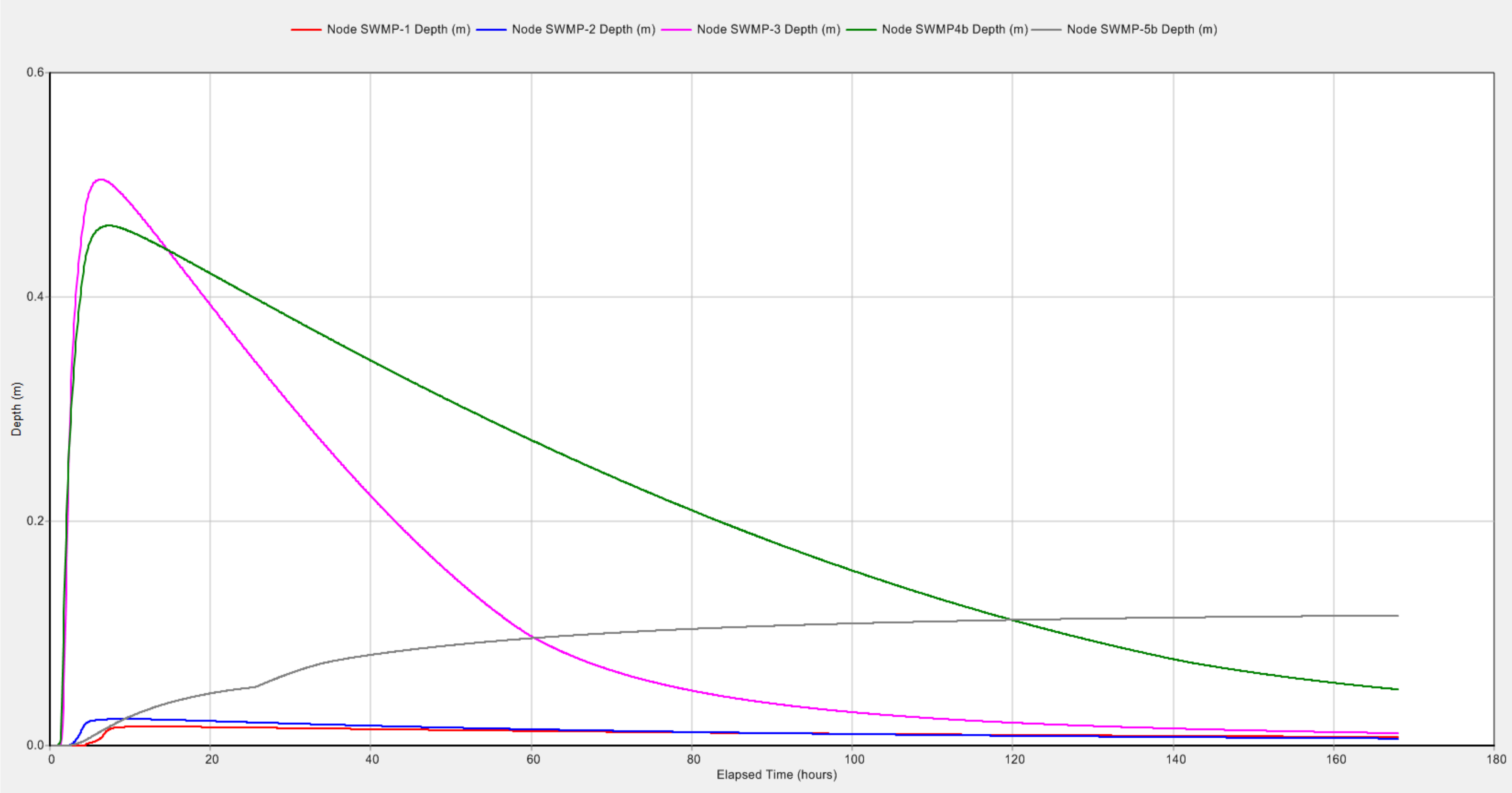
ATTACHMENT A.3

24 hr Detention Time Assessment / Verification Hydrographs

Figure:

Figure A-3 – 25mm – 4 hr, City of Ottawa Design Storm Hydrographs for CRRRC SWMPs

CRRRC - SWMPs - Depths above NWL (m) - 25 mm, 4 hr Design Storm	Figure A-3



PROJECT: 1787048
DATE: June 2018

GOLDER

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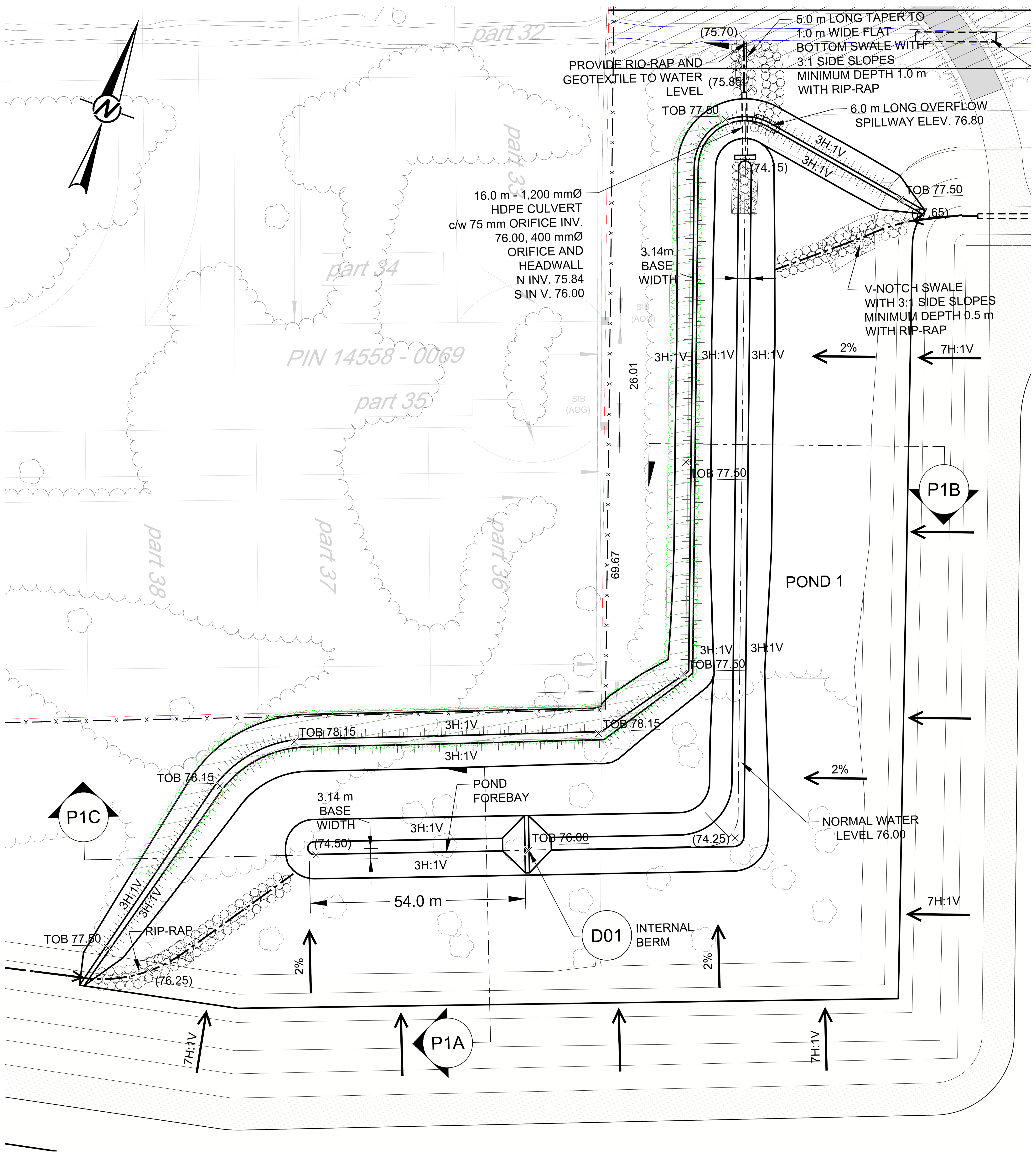
ATTACHMENT B

Drawings



PLAN VIEW OF POND 1

SCALE 1:750 m

POND 1 LEVEL

NORMAL WATER LEVEL = 76.00

1:2 EVENT LEVEL = 76.68

1:5 EVENT LEVEL = 76.97

1:25 EVENT LEVEL = 77.31

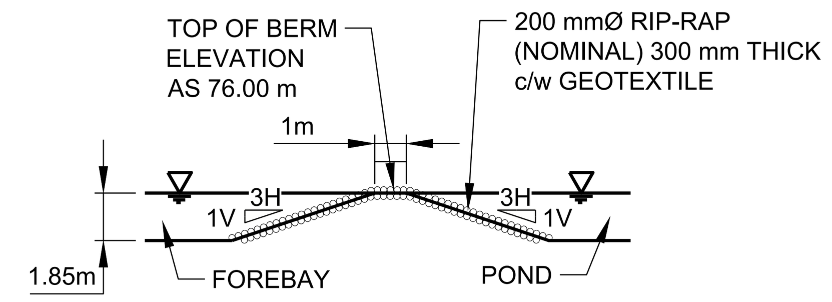
1:100 EVENT LEVEL = 77.52

LEGEND

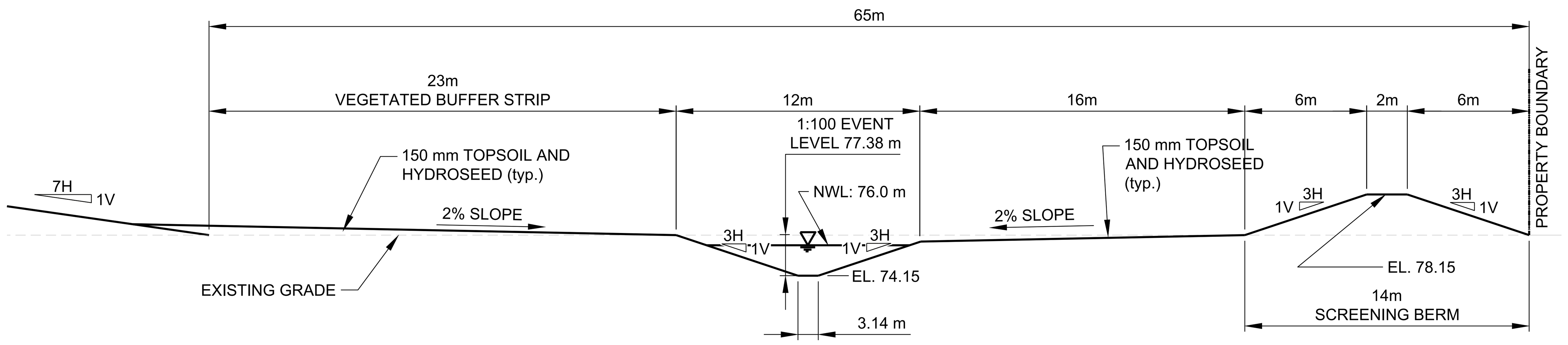
	PROPOSED BOUNDARY
× (75.50)	PROPOSED SWALE GRADE
× 77.25	PROPOSED GRADE
× TOB 77.25	PROPOSED TOP OF BERM GRADE
H.P.	HIGH POINT
	PROPOSED SURFACE DRAINAGE DIRECTION
	PROPOSED RIP-RAP (NOMINAL 200 mmØ, 300 mm THICK c/w GEOTEXTILE)
× 75.8	EXISTING GRADE
	PROPOSED DITCH
	PROPOSED 600 mmØ CULVERT OR AS NOTED
	EXISTING CULVERT AS NOTED

NOTE(S)

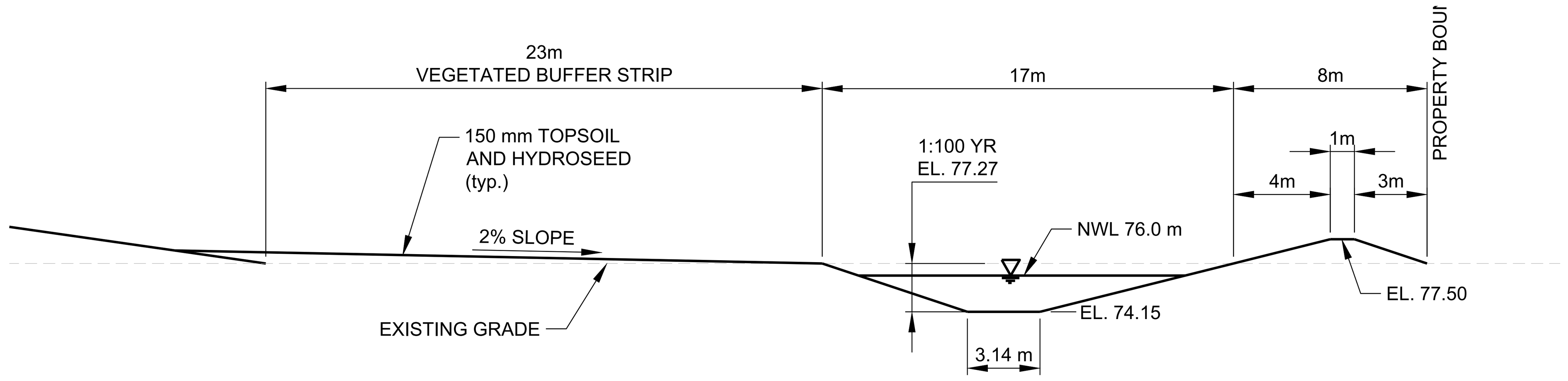
1. ALL GRADES ARE METRES ABOVE SEA LEVEL (masl)
2. TO BE READ IN CONJUNCTION WITH GRADING PLAN NO. GD1 TO GD14.



SCALE 1:200 m D01 INTERNAL BERM DETAIL POND 1



SCALE 1:200 m P1A SECTION



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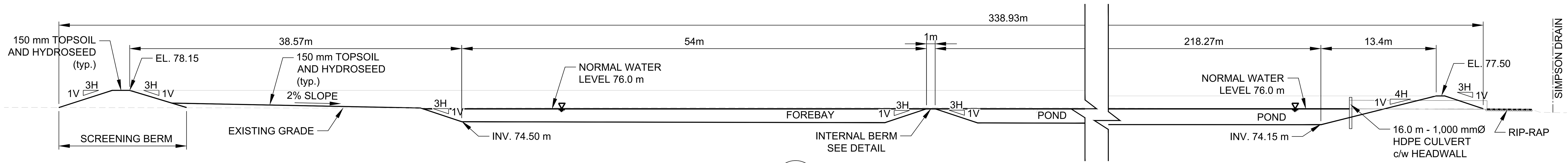

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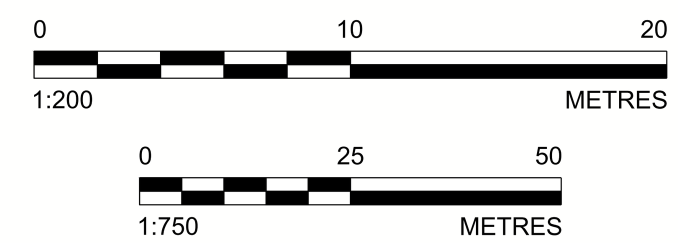

REV.	YYYY-MM-DD	DESCRIPTION	DESIGNED	PREPARED	REVIEWED	APPROVED
1	2018-06-15	ISSUED FOR SITE PLAN APPROVAL	MHK	MLF	DVK	DVK

SEAL

LICENSED PROFESSIONAL ENGINEER M.H.H. KNOWLES 100113750 PROVINCE OF ONTARIO

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CANADA
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www.golder.com

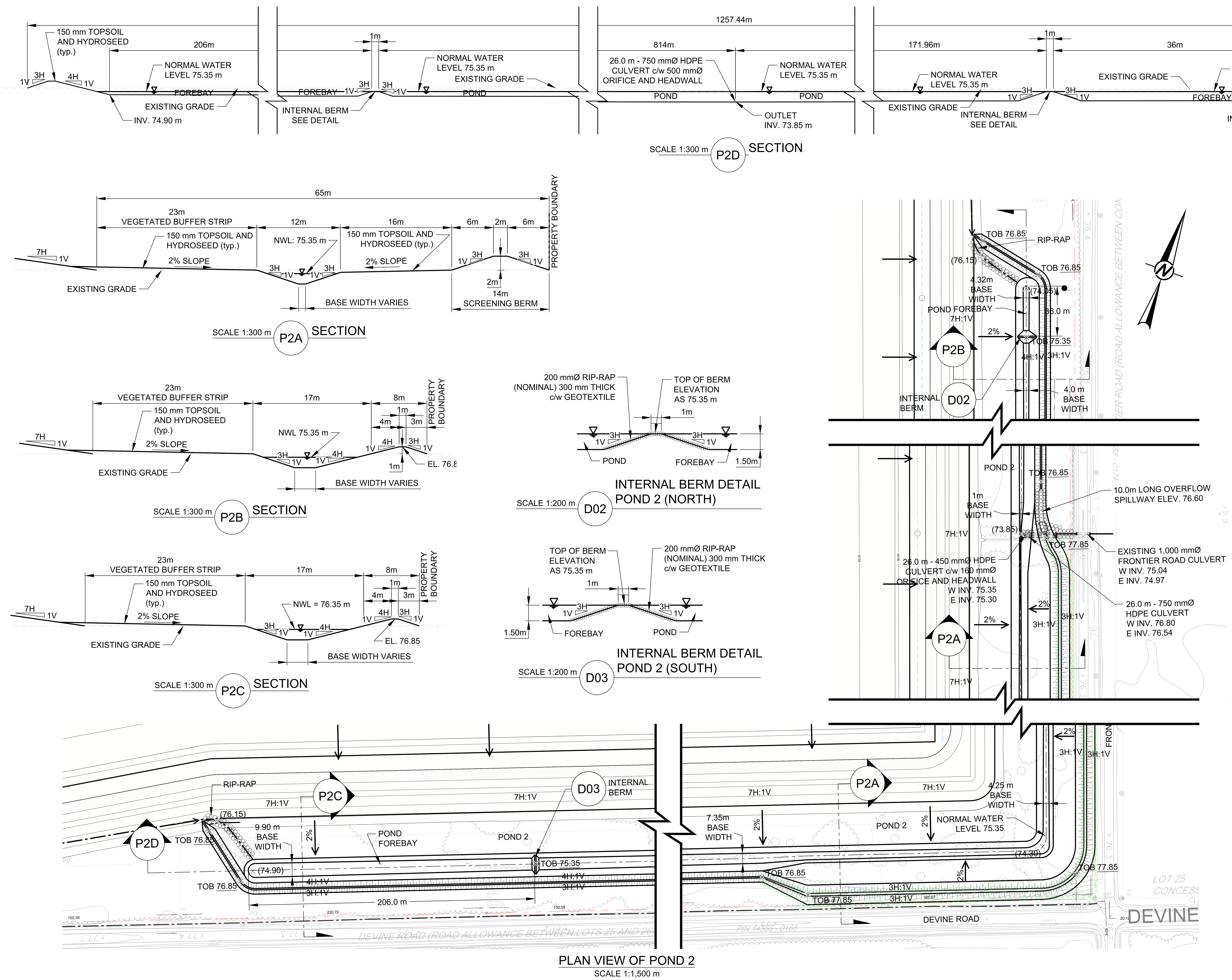
PROJECT

CAPITAL REGION RESOURCE RECOVERY CENTRE

TITLE

POND 1 PLAN VIEW AND DETAILS

PROJECT NO.	CONTROL	REV.	of	DRAWING
1787048	0006	1		C27



LEGEND

- PROPERTY BOUNDARY
- × (75.50) PROPOSED SWALE GRADE
- × 77.25 PROPOSED GRADE
- × TOB 77.25 PROPOSED TOP OF BERM GRADE
- H.P. HIGH POINT
- PROPOSED SURFACE DRAINAGE DIRECTION
- PROPOSED RIP-RAP (NOMINAL 200 mmØ, 300 mm THICK c/w GEOTEXTILE)
- × 75.8 EXISTING GRADE
- PROPOSED DITCH
- PROPOSED 600 mmØ CULVERT OR AS NOTED
- EXISTING CULVERT AS NOTED

NOTE(S)

1. ALL GRADES ARE METRES ABOVE SEA LEVEL (masl)
2. TO BE READ IN CONJUNCTION WITH GRADING PLAN NO. GD1 TO GD14.

POND 2 LEVEL

NORMAL WATER LEVEL = 75.35

1:2 EVENT LEVEL = 76.16

1:5 EVENT LEVEL = 76.22

1:25 EVENT LEVEL = 76.61

1:100 EVENT LEVEL = 76.71

0 10 20 1:300 METRES

0 50 100 1:1,500 METRES

REV.	YYYY-MM-DD	DESCRIPTION	DESIGNED	PREPARED	REVIEWED	APPROVED
1	2018-06-15	ISSUED FOR SITE PLAN APPROVAL	MHK	MLF	DVK	DVK

SEAL

LICENSED PROFESSIONAL ENGINEER June 15, 2018 M.H.H. KNOWLES 100113790 PROVINCE OF ONTARIO

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TAGGART MILLER ENVIRONMENTAL SERVICES

CONSULTANT
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PROJECT
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TITLE
POND 2 PLAN VIEW AND DETAILS

PROJECT NO.	CONTROL	REV.	of	DRAWING
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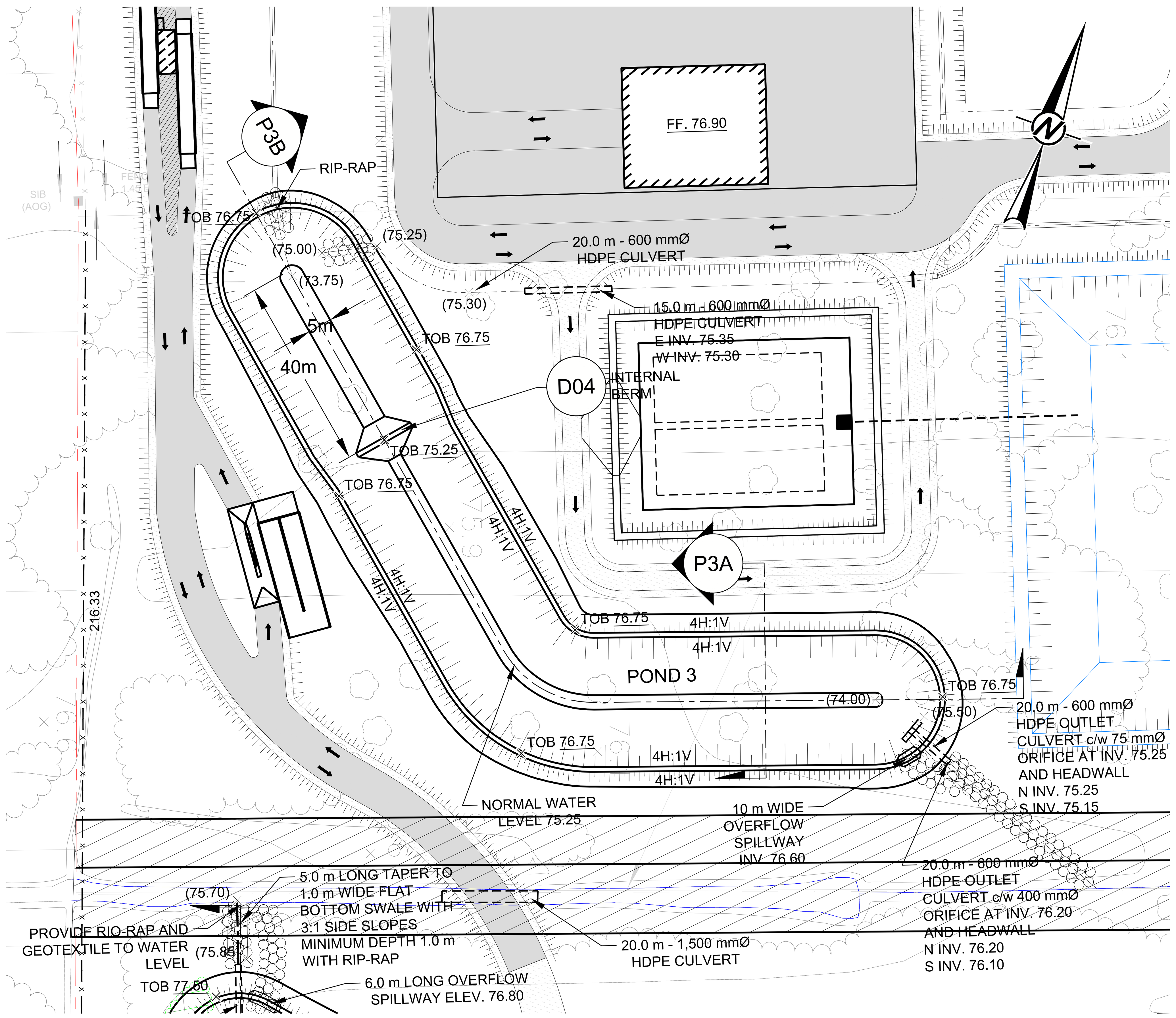


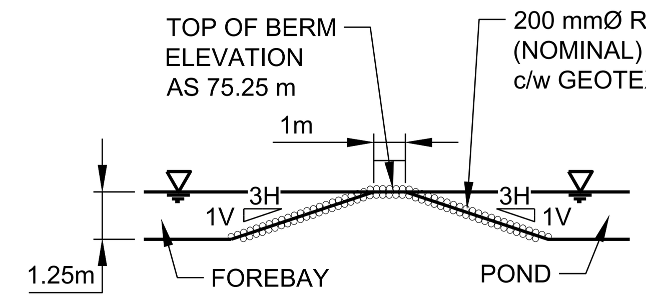
PLAN VIEW OF POND 3
SCALE 1:750 m

POND 3 LEVEL
NORMAL WATER LEVEL = 75.25
1:2 EVENT LEVEL = 76.23
1:5 EVENT LEVEL = 76.37
1:25 EVENT LEVEL = 76.58
1:100 EVENT LEVEL = 76.67

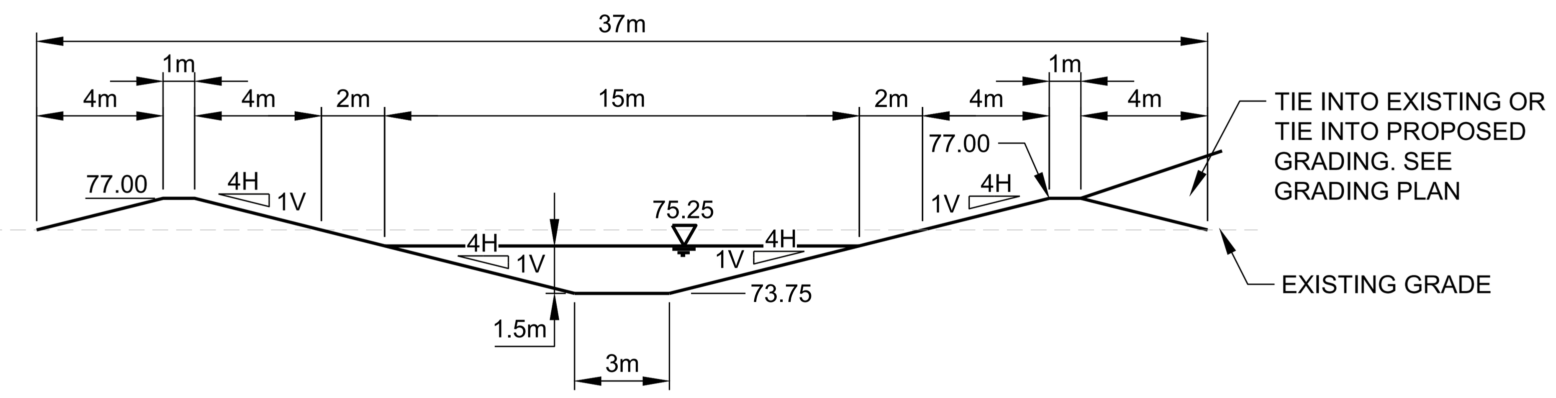
LEGEND

— · —	PROPERTY BOUNDARY
× (75.50)	PROPOSED SWALE GRADE
× 77.25	PROPOSED GRADE
× TOB 77.25	PROPOSED TOP OF BERM GRADE
H.P.	HIGH POINT
←	PROPOSED SURFACE DRAINAGE DIRECTION
	PROPOSED RIP-RAP (NOMINAL 200 mmØ, 300 mm THICK c/w GEOTEXTILE)
× 75.8	EXISTING GRADE
	PROPOSED DITCH
	PROPOSED 600 mmØ CULVERT OR AS NOTED
	EXISTING CULVERT AS NOTED

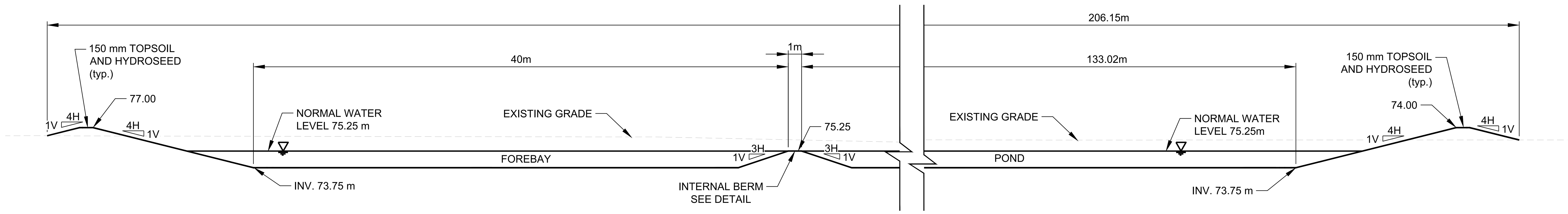
NOTE(S)
1. ALL GRADES ARE METRES ABOVE SEA LEVEL (masl)
2. TO BE READ IN CONJUNCTION WITH GRADING PLAN NO. GD1 TO GD14.



SCALE 1:200 m D04 INTERNAL BERM DETAIL POND 3



SCALE 1:200 m P3A SECTION



SCALE 1:200 m P3B SECTION

0 10 20
1:200 METRES

0 25 50
1:750 METRES

REV.	YYYY-MM-DD	DESCRIPTION	DESIGNED	PREPARED	REVIEWED	APPROVED
1	2018-06-15	ISSUED FOR SITE PLAN APPROVAL	MHK	MLF	DVK	DVK

SEAL

LICENSED PROFESSIONAL ENGINEER
June 15, 2018
M.H.H. KNOWLES
100113790
PROVINCE OF ONTARIO

CLIENT
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PROJECT
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TITLE
POND 3 PLAN VIEW AND DETAILS

PROJECT NO.	CONTROL	REV.	of	DRAWING
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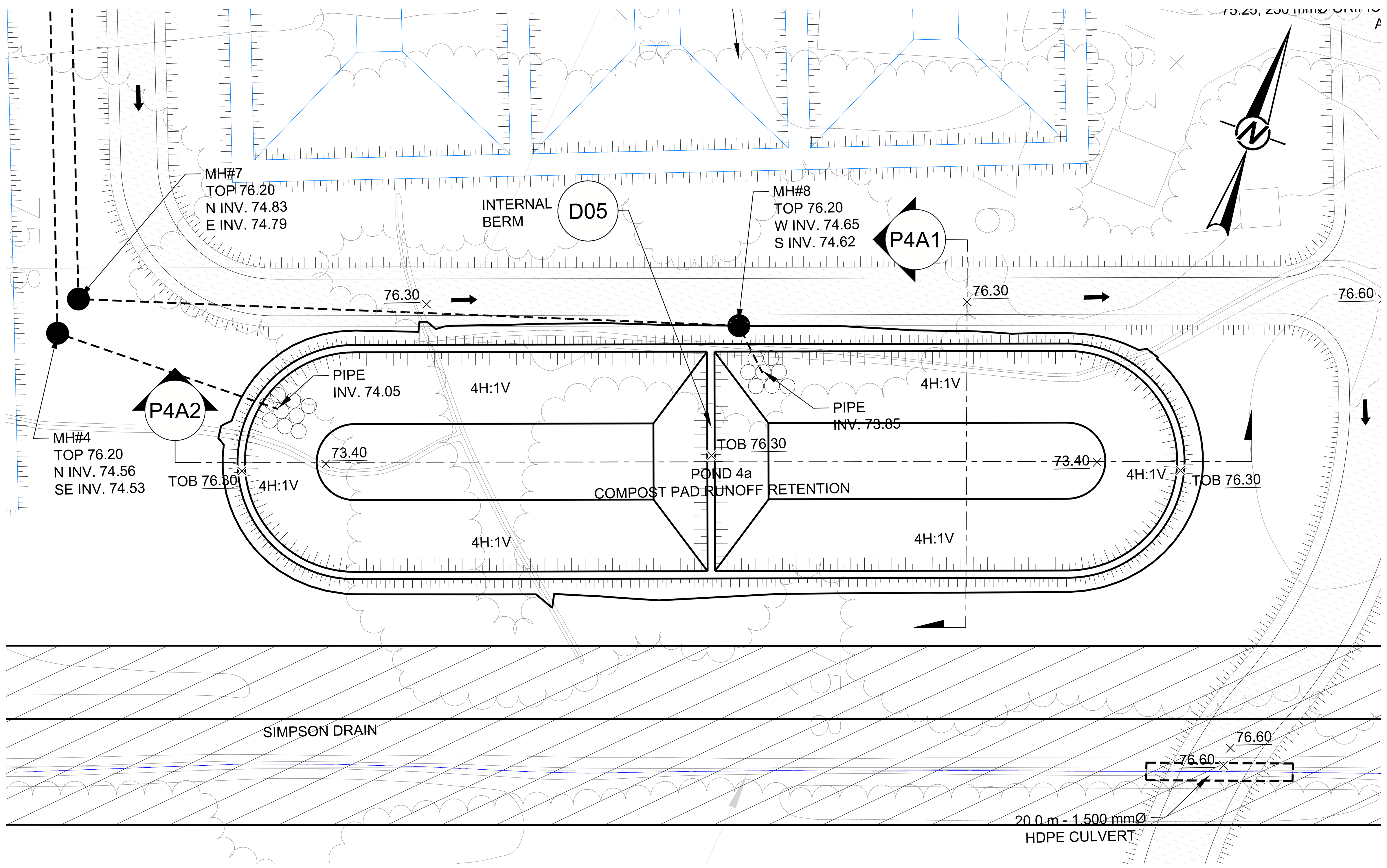
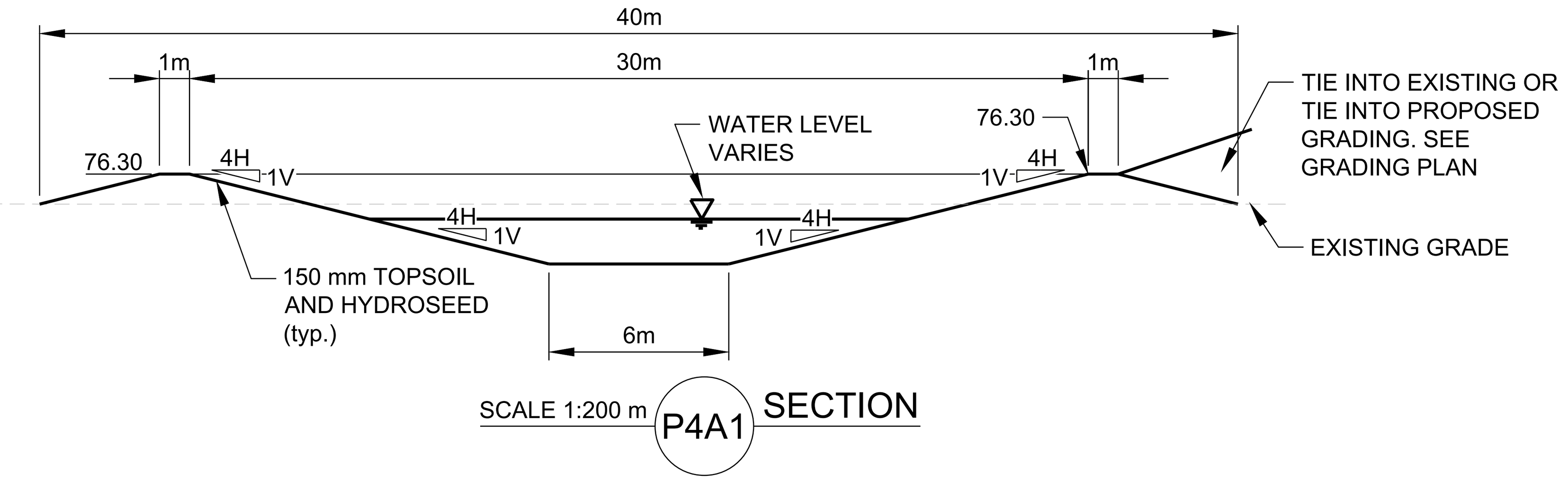


PLAN VIEW OF POND 4A
SCALE 1:500 m



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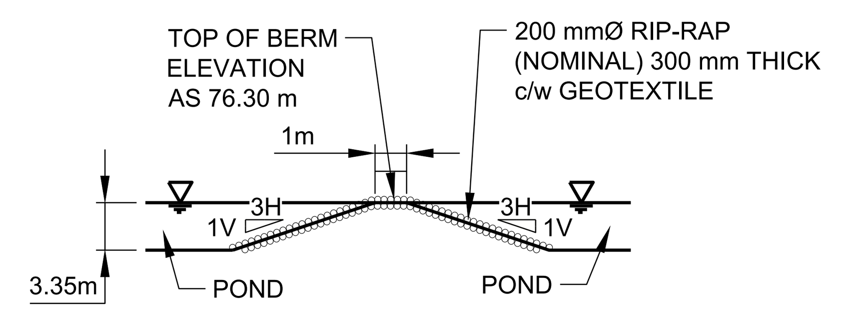
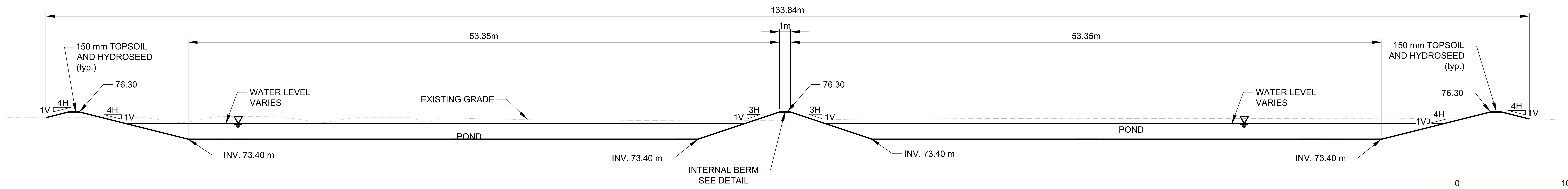


SCALE 1:200 m D05 INTERNAL BERM DETAIL POND 4A



SCALE 1:200 m P4A2 SECTION

POND 4A LEVEL
1:2 EVENT LEVEL = 74.71
1:5 EVENT LEVEL = 75.00
1:25 EVENT LEVEL = 75.47
1:100 EVENT LEVEL = 75.77

LEGEND

	PROPERTY BOUNDARY
× (75.50)	PROPOSED SWALE GRADE
× 77.25	PROPOSED GRADE
× TOB 77.25	PROPOSED TOP OF BERM GRADE
H.P.	HIGH POINT
←	PROPOSED SURFACE DRAINAGE DIRECTION
	PROPOSED RIP-RAP (NOMINAL 200 mmØ, 300 mm THICK c/w GEOTEXTILE)
× 75.8	EXISTING GRADE
	PROPOSED DITCH
	PROPOSED 600 mmØ CULVERT OR AS NOTED
	EXISTING CULVERT AS NOTED

NOTE(S)
1. ALL GRADES ARE METRES ABOVE SEA LEVEL (masl)
2. TO BE READ IN CONJUNCTION WITH GRADING PLAN NO. GD1 TO GD14.

0 10 20
1:200 METRES

0 20 40
1:500 METRES

REV.	YYYY-MM-DD	DESCRIPTION	DESIGNED	PREPARED	REVIEWED	APPROVED
1	2018-06-15	ISSUED FOR SITE PLAN APPROVAL	MHK	MLF	DVK	DVK

SEAL

CLIENT
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PROJECT
CAPITAL REGION RESOURCE RECOVERY CENTRE

TITLE
POND 4a PLAN VIEW AND DETAILS

PROJECT NO.	CONTROL	REV.	of	DRAWING
1787048	0006	1		C30

25 mm IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI D

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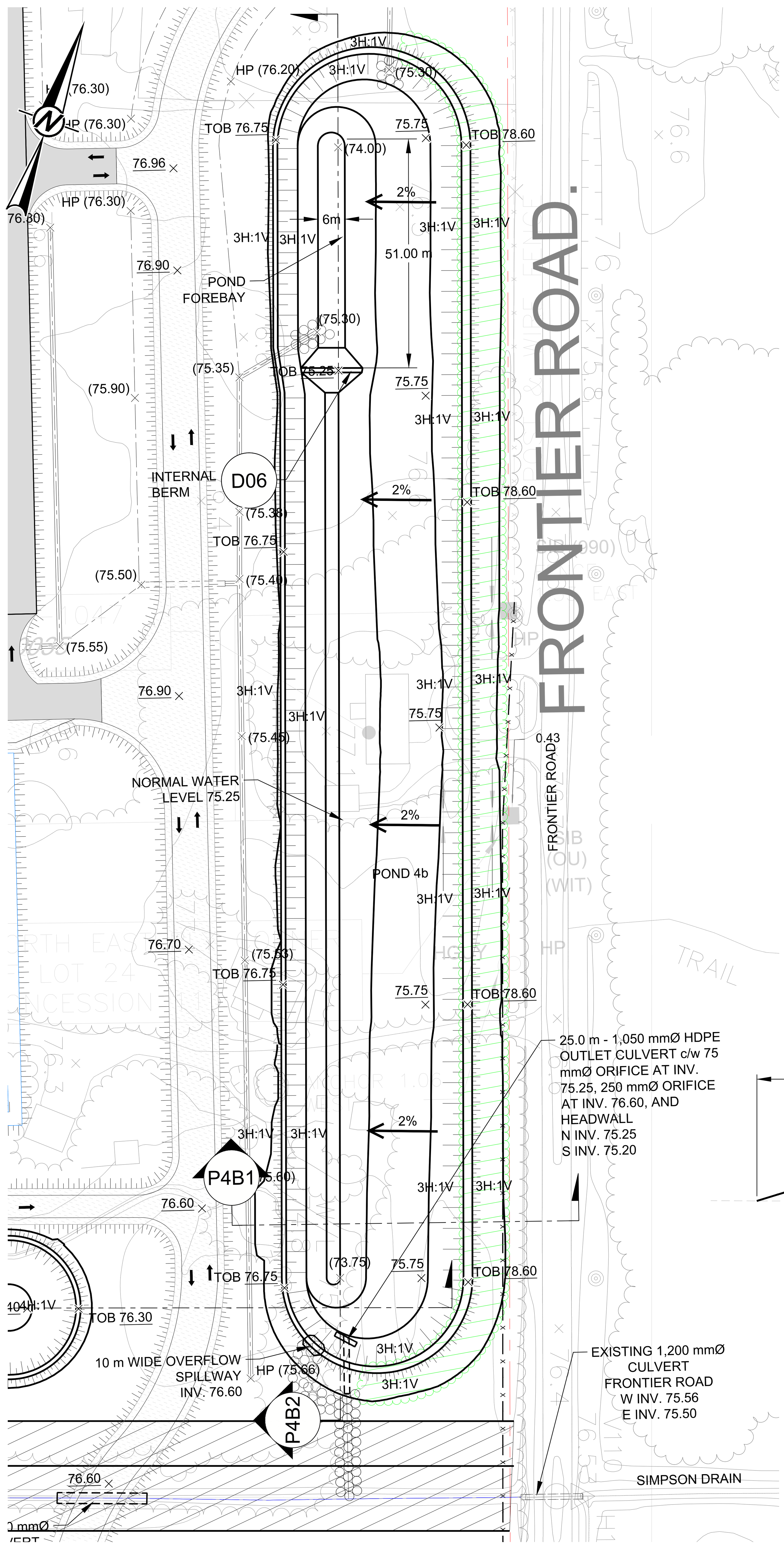
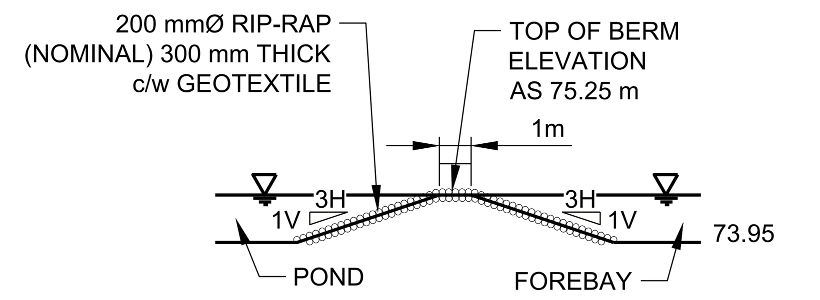


PLAN VIEW OF POND 4B
SCALE 1:750 m



SCALE 1:200 m D06 INTERNAL BERM DETAIL POND 4B

POND 4B LEVEL

NORMAL WATER LEVEL = 75.25

1:2 EVENT LEVEL = 76.21

1:5 EVENT LEVEL = 76.38

1:25 EVENT LEVEL = 76.63

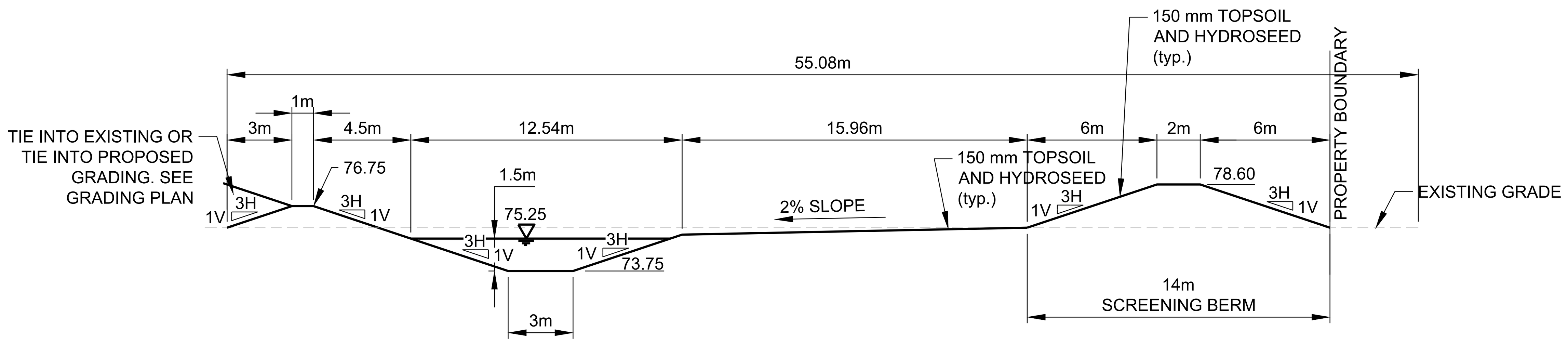
1:100 EVENT LEVEL = 76.69

LEGEND

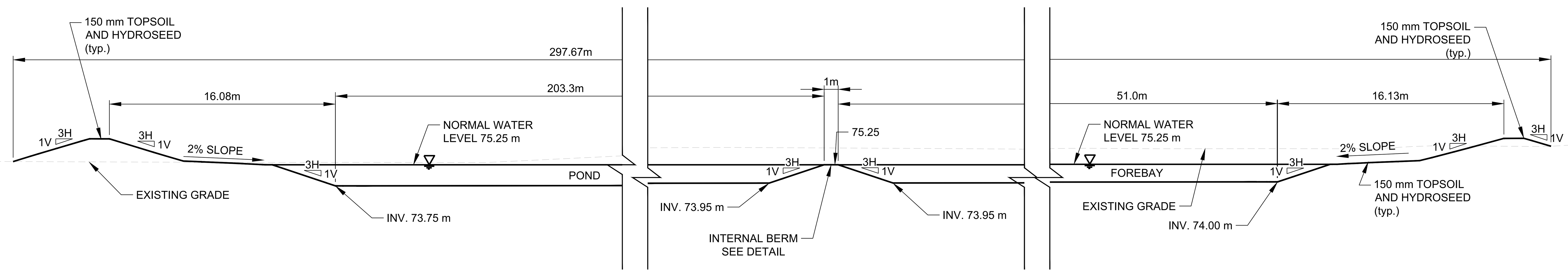
	PROPERTY BOUNDARY
× (75.50)	PROPOSED SWALE GRADE
× 77.25	PROPOSED GRADE
× TOB 77.25	PROPOSED TOP OF BERM GRADE
H.P.	HIGH POINT
	PROPOSED SURFACE DRAINAGE DIRECTION
	PROPOSED RIP-RAP (NOMINAL 200 mmØ, 300 mm THICK c/w GEOTEXTILE)
	EXISTING GRADE
	PROPOSED DITCH
	PROPOSED 600 mmØ CULVERT OR AS NOTED
	EXISTING CULVERT AS NOTED

NOTE(S)

1. ALL GRADES ARE METRES ABOVE SEA LEVEL (masl)
2. TO BE READ IN CONJUNCTION WITH GRADING PLAN NO. GD1 TO GD14.



SCALE 1:200 m P4B1 SECTION



SCALE 1:200 m P4B2 SECTION

0 10 20
1:200 METRES

0 25 50
1:750 METRES

REV.	YYYY-MM-DD	DESCRIPTION	DESIGNED	PREPARED	REVIEWED	APPROVED
1	2018-06-15	ISSUED FOR SITE PLAN APPROVAL	MHK	MLF	DVK	DVK

SEAL

LICENSED PROFESSIONAL ENGINEER
June 15, 2018
M.H.H. KNOWLES
100113790
PROVINCE OF ONTARIO

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PROJECT
CAPITAL REGION RESOURCE RECOVERY CENTRE

TITLE
POND 4b PLAN VIEW AND DETAILS

PROJECT NO.	CONTROL	REV.	of	DRAWING
1787048	0006	1		C31

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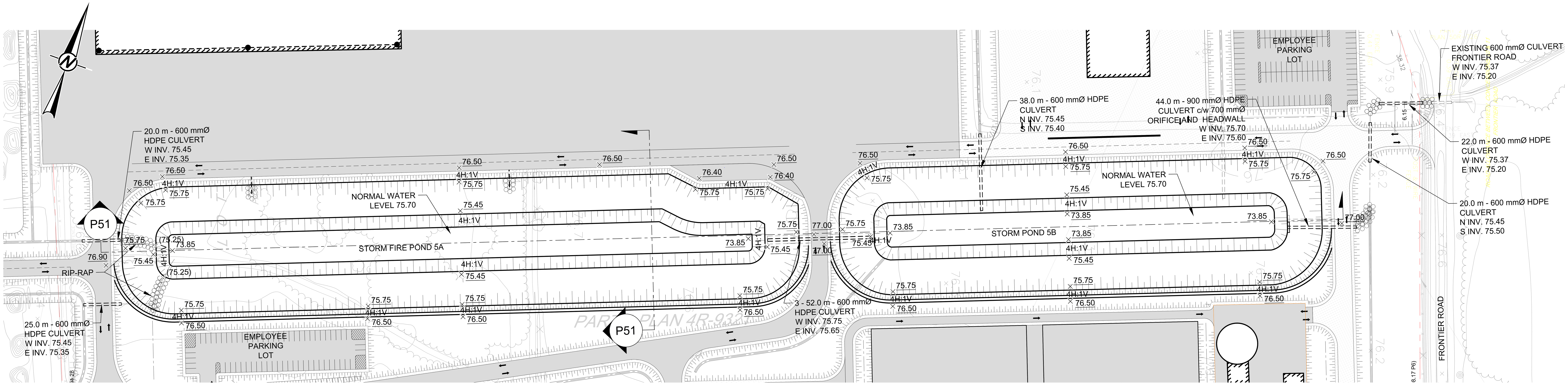


PLAN VIEW OF POND 5A AND 5B

SCALE 1:1000

POND 5A LEVEL

NORMAL WATER LEVEL = 75.70

1:2 EVENT LEVEL = 75.94

1:5 EVENT LEVEL = 76.00

1:25 EVENT LEVEL = 76.12

1:100 EVENT LEVEL = 76.19

POND 5BLEVEL

NORMAL WATER LEVEL = 75.70

1:2 EVENT LEVEL = 75.94

1:5 EVENT LEVEL = 76.00

1:25 EVENT LEVEL = 76.12

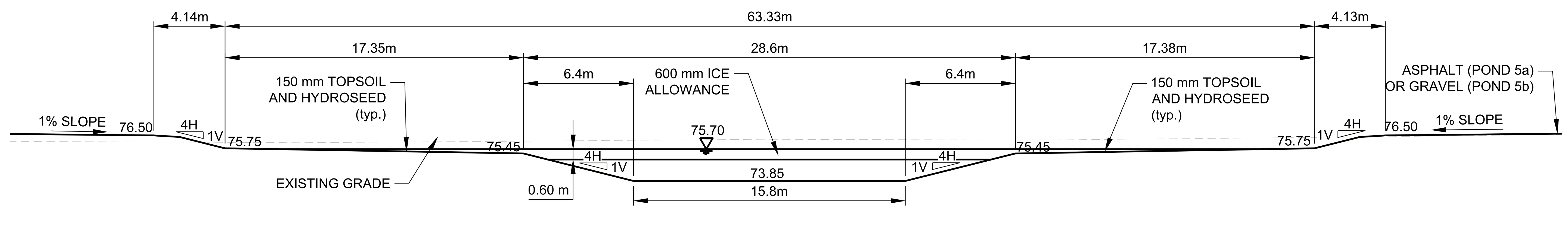
1:100 EVENT LEVEL = 76.19

LEGEND

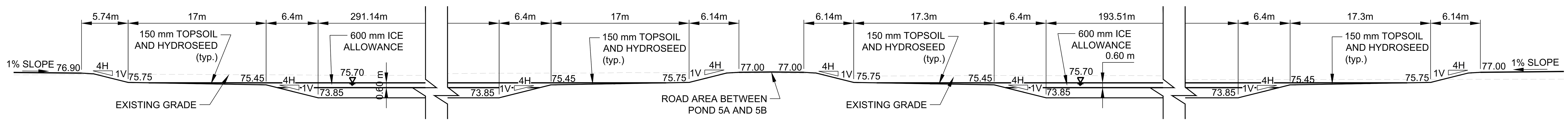
	PROPERTY BOUNDARY
× (75.50)	PROPOSED SWALE GRADE
× 77.25	PROPOSED GRADE
× TOB 77.25	PROPOSED TOP OF BERM GRADE
H.P.	HIGH POINT
←	PROPOSED SURFACE DRAINAGE DIRECTION
	PROPOSED RIP-RAP (NOMINAL 200 mmØ, 300 mm THICK c/w GEOTEXTILE)
75.8	EXISTING GRADE
	PROPOSED DITCH
	PROPOSED 600 mmØ CULVERT OR AS NOTED
	EXISTING CULVERT AS NOTED

NOTE(S)

1. ALL GRADES ARE METRES ABOVE SEA LEVEL (masl)
2. TO BE READ IN CONJUNCTION WITH GRADING PLAN NO. GD1 to GD14.



SCALE 1:200 m P51 TYPICAL SECTION FOR POND 5A AND 5B



SCALE 1:300 m P52 SECTION POND 5A AND 5B

0	10	20
1:200		METRES

0	10	20
1:300		METRES

0	50	100
1:1,000		METRES

REV.	YYYY-MM-DD	DESCRIPTION	DESIGNED	PREPARED	REVIEWED	APPROVED
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SEAL

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PROJECT

CAPITAL REGION RESOURCE RECOVERY CENTRE

TITLE

PLAN VIEW OF STORM - FIRE POND 5A AND 5B AND DETAILS

PROJECT NO.	CONTROL	REV.	of	DRAWING
1787048	0006	1		C32

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